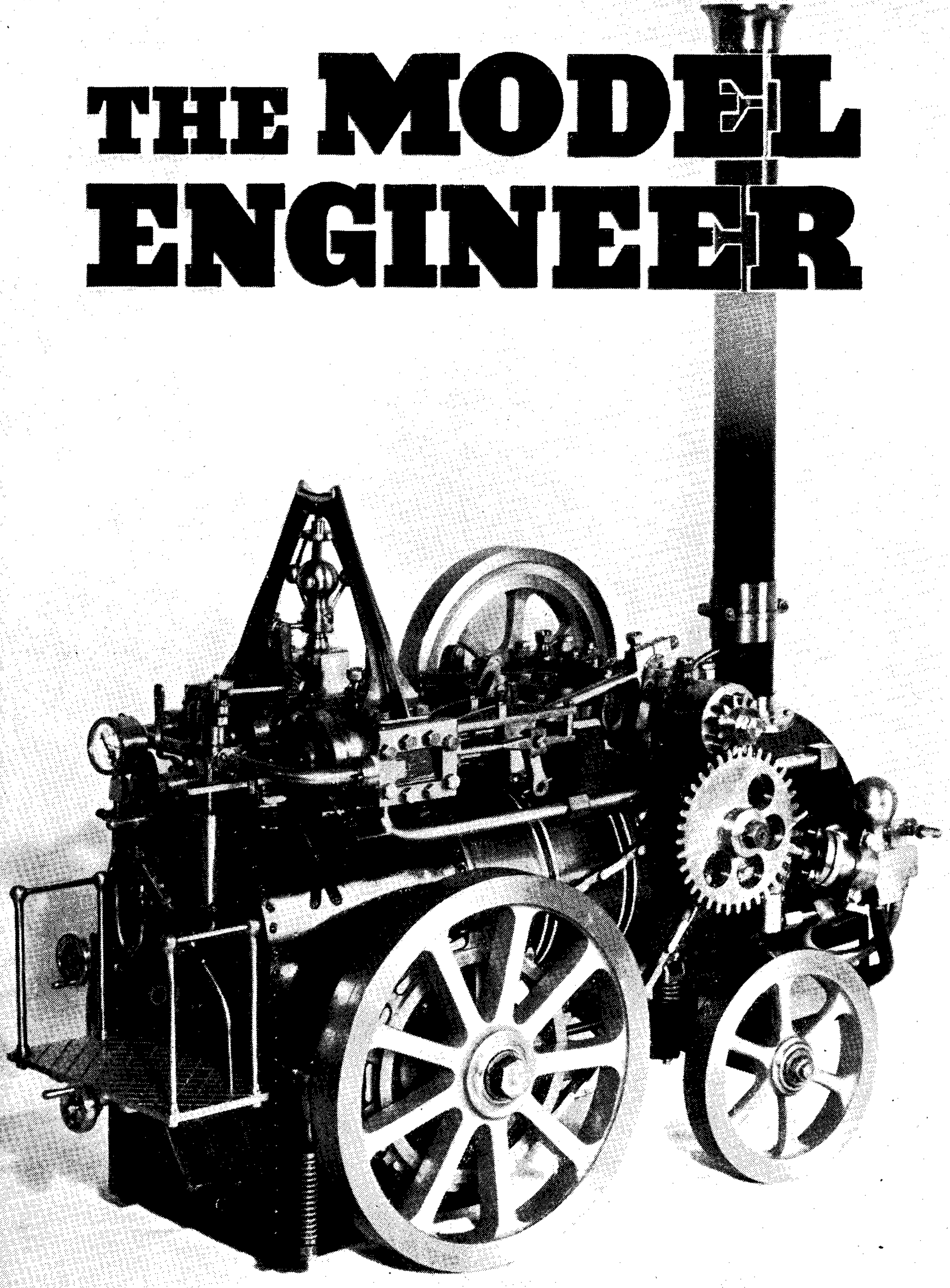
THE MODEL ENGINEER



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The MODEL ENGINEER

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SMOKE RINGS

An Interesting Old Locomotive

● THROUGH the wholehearted co-operation of the French Railway administration, visitors to the South Bank Exhibition of the Festival of Britain, 1951, will be able to inspect a 2-2-2 "Buddicom" express passenger locomotive belonging to the French Railways.

The locomotive was built by Allcard, Buddicom et Cie, at Chartreux, near Rouen, in the early 1840's. Greatly esteemed on the Continent as one of the outstanding early contributions to steam locomotive development, the "Buddicom" is still in running order after a century of service. Though its equally famous contemporary, the "Crampton," achieved its greatest fame only in France (a fame which is still undimmed there), the "Buddicom" was to be found during the 19th and part of the 20th century in most of the countries of Europe. It figured on railways in Italy, Spain, France, Canada, and elsewhere, and was long favourite on railways in this country, where it was known as the "Crewe" type.

The association of three men was responsible for the "Buddicom's" development and wide use. They were Joseph Locke, one of the great railway civil engineers who designed railways in France, Spain and elsewhere; Thomas Brassey, perhaps the greatest figure among public works contractors (100 years ago he employed over 70,000 men on railway construction throughout the world, and his contracts amounted to the staggering figure of £28,000,000); and William Barber Buddicom, one-time locomotive superintendent of the Grand Junction Railway.

Mr. Harold Wyatt, of the Council of Industrial Design, who is responsible for the railway exhibits at the Festival of Britain, seized on the "Buddicom" as one of the most important links in the story of Britain's early world railway prestige. His interest in this engine was echoed in France, and as a result, the locomotive will be exhibited in 1951. Mr. Wyatt found a great evidence of the British railway tradition in France, even meeting, in M. Maurice Cook, a railway telegraph linesman of the Western Region of French Railways, a descendant of one of Buddicom's engine drivers.

Recently fully overhauled in the French locomotive shops, the "Buddicom" will leave Paris early in January, 1951, and will travel to Dunkirk, where it will be shipped on the train-ferry to Dover. From Dover it will make its journey to Bricklayers Arms Station, London—the first known occasion on which a foreign-built "Buddicom" locomotive will have been seen in the country whose engineering skill produced it.

Lack of Observation?

● MR. J. R. THOROUGOOD, hon. secretary of the English Electric and Napier (Liverpool) Model Engineering Club has written to let us know that the club continues to prosper. The latest venture is a track, 100 yards long and accommodating 3½-in. and 5-in. gauges. Its construction was begun last May with a view to having it ready for use in August, and we are glad to learn that this object was achieved. The rails are 1-in. by $\frac{3}{16}$-in. T-iron spiked direct to wooden sleepers at 6-in. spacing, and laid on rolled cinders. Rolling-stock is of light steel construction, each truck running on two four-wheel bogies which take the form of some described not long ago in THE MODEL ENGINEER.

The photograph reproduced on this page is a view looking towards one end of the track; it shows that the approach road diverges into a Y, to serve two station platforms, and the general effect is neat and pleasing.

The bracket-signal is a prominent feature; but why are the arms the wrong way about?

Calling Greenock and Walsall

● THE DESIRE to set up model engineering societies in towns where no such facilities at present exist seems to be as strong as ever. Mr. A. E. Keown, whose address is 41, Rodney Road, Gourock, writes: "I have recently returned from abroad and looked forward to contacting some fellow model engineers. Much to my intense surprise, however, model engineers in this district appear to be conspicuous by their absence, or perhaps hide their lights under the proverbial bushel.

"I feel sure that in Gourock and the adjacent town of Greenock, with a population of some 70,000, there must exist a number of our fraternity, possibly like myself, up to now, lone hands.

"It would greatly be appreciated if, through the medium of your columns, you would broadcast an appeal to any model engineers in this district to contact me at the above address.

"Perhaps it is a little ambitious, at this stage, to speak of the formation of a club, but it would be grand if a few of us could get together, if only for the occasional chat and exchange of ideas."

We feel that Mr. Keown's letter speaks well enough for itself, and we are pleased to quote it. We hope it will bring the immediate result he desires and lead to the more ambitious project later.

From Walsall, Staffs, comes a letter expressing a similar desire on the part of Mr. John F. Trump, who writes: "I am a lone hand very interested in model engineering in all forms. I would like to contact other model engineers in my district, with a view to forming a model engineering society.

"I should be very pleased if you could insert a small note in THE MODEL ENGINEER to this effect."

Well, there it is, and we hope it will catch the eyes of many neighbours of Mr. Trump, whose address is 92, Webster Road, Walsall.

Exeter and District M.E.S. Headquarters

● LIKE so many other societies, the Exeter and District Model Engineers' Society has been looking for suitable headquarters for several years. We are glad to learn, from the latest issue of the society's *Bulletin*, that the problem has now been solved, and in somewhat unusual circumstances which we feel are worth calling to the attention of any other societies which may be trying to solve a similar problem.

In 1949, the society collaborated with a number of other Exeter societies to organise an exhibition in conjunction with the Devon Industries Fair. After that event, Mr. Mummery, treasurer of the Exeter Radio Society made numerous enquiries, hoping to discover a suitable house, hut or other sort of edifice. He wrote to the local paper, the *Express and Echo*, the editor of which published the letter. This brought a reply from the St. David's Institute, offering a large army hut at an attractive rental.

The upshot was that the Exeter M.E.S., Exeter Radio Society and Exeter Aircraft Society have joined forces as tenants of the hut, which they are at present adapting and fitting up to meet their requirements.

Two Old-Time Models — and a Newer One

by W. J. Hughes

(Photographs by Photo Press Agency, Sheffield)

A FEW months ago I had the good fortune to be introduced to Mr. H. C. Chambers, who is a well-known resident of a village in North-East Derbyshire. I had heard that he had what was described to me as a "beautiful model agricultural engine," and though this was not the chief reason why I was happy to meet him, I must confess I was keen to see it.

That my keenness was justified will be evident from the photographs which accompany this article; for, while the model is not of a "traction engine" of the type with which most people are familiar, the design is most interesting, and has many ingenious and unusual features. Furthermore, the beautiful workmanship of even the smallest items on the model betokens a sense of craftsmanship on behalf of the builder which would do credit to anyone.

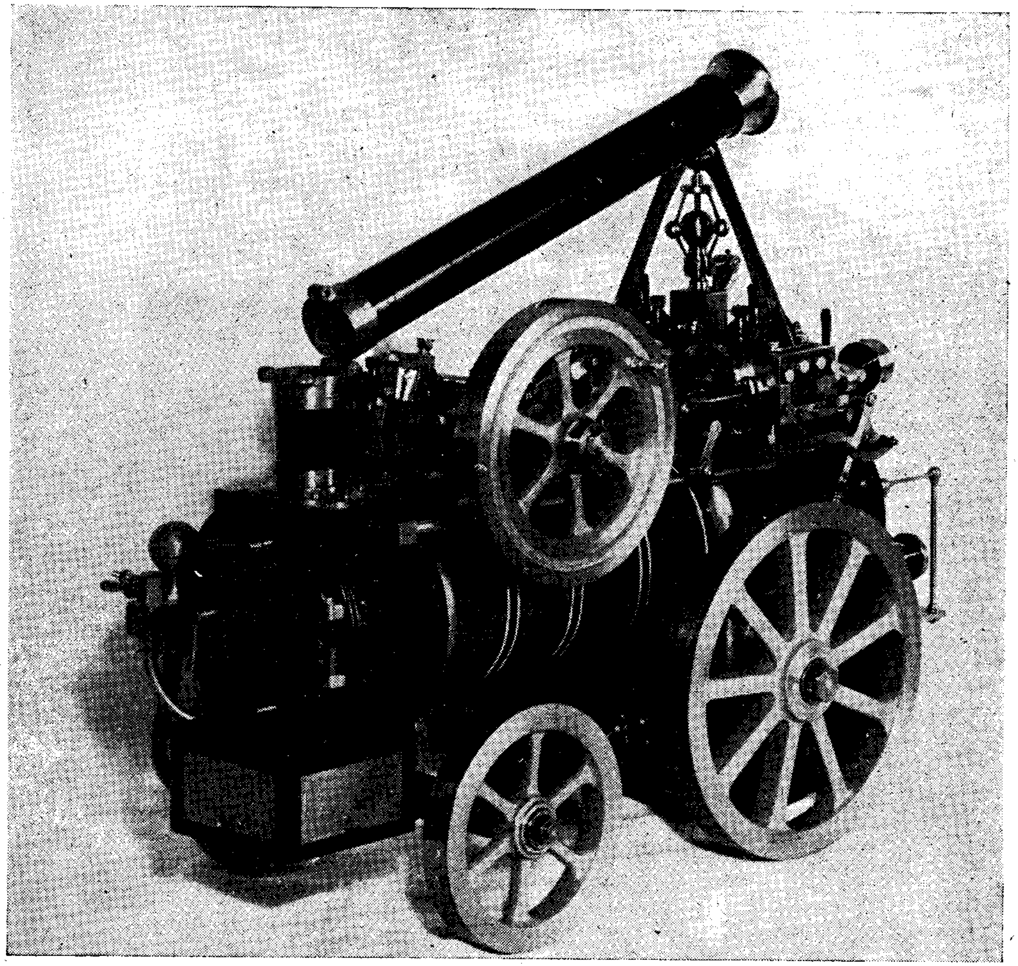


Fig. 1. General view of the half-century-old model of a "self-moving agricultural engine" designed and built by the late Captain T. J. Tresidder, R.E., C.M.G.

The Builder of the Model

The engine was designed and built by the late Captain T. J. Tresidder, R.E., C.M.G., and bears the dates 1893-1897, so that it was completed over half a century ago. It is interesting to recall that during an honourable army career, Capt. Tresidder was lent by the British Government to the Governor of Malta, on which island he spent ten years re-organising and re-arranging the water supply and the drainage system.

After this, and following a period at the War Office, the captain joined the famous Sheffield firm of John Brown Ltd., as technical adviser, attending trials of guns, shells and armour-plate among his other multifarious duties. He was a director of the firm (later Thomas Firth and John Brown Ltd.), for thirty-three years until his retirement. He was also the author of many articles on ballistics, naval gunnery and other scientific and technical matters.

Throughout his life, Capt. Tresidder was an ingenious and very inventive man, and his craftsmanship was of a high order (In a later article I hope to describe one of his inventions, the neo-micrometer, which might have proved very important had it not been produced in a period of slump.)

The Model Agricultural Engine

In general design, the model agricultural engine conforms to the period of the first "self-moving" road engines, which were adapted round about 1860 from portable engine design, by adding a chain drive. It certainly possesses many features of that period, including cylinders over the firebox with crankshaft at the smokebox end, the very short wheelbase obtained by having the hind wheels well forward and the front axle well back, the tall, parallel chimney hinged at the base, the chain drive, and so on. At the same time there are refinements such as springing, steering from the footplate end, valve gear with variable cut-off, reduction gearing for the pump, and so on, which definitely are *not* typical of the 1860 period, and which are due to the builder's own ideas.

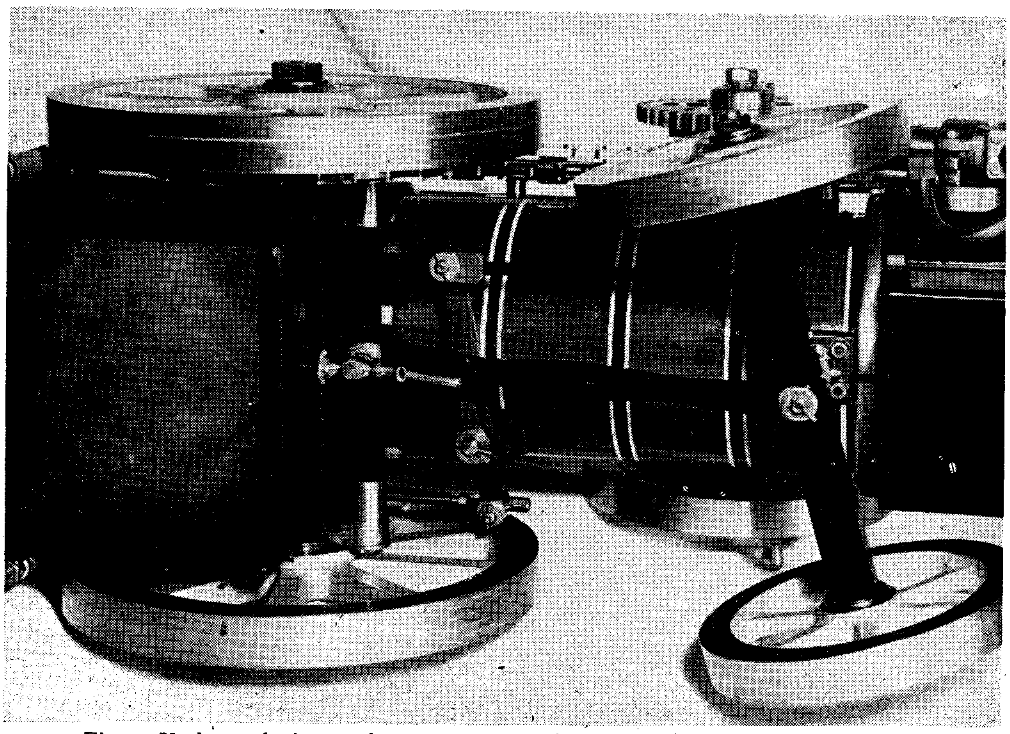


Fig. 2. Underneath view, to show arrangement of steering-gear, as described in the text

Mr. Chambers, who was the son-in-law of Capt. Tresidder, told me that the engine was entirely designed by the builder, with improvements of his own, and the latter statement no doubt refers to the refinements just mentioned. But not only was the design due to the builder—every part of it, down to the last rivet and screw, was *personally* made by him, with the exception of the pressure gauge.

Some of the chief dimensions are as follows:

Height to top of extended chimney	$16\frac{1}{4}$ in.
Height to top of flywheel ..	$11\frac{1}{2}$ in.
Hind wheels	7 in. dia. × $\frac{3}{4}$ in.
Flywheel	$5\frac{1}{4}$ in. dia. × $\frac{5}{8}$ in.
Width overall	$8\frac{1}{4}$ in.
C.L. boiler "above ground"	$5\frac{7}{8}$ in.
Front wheels	$4\frac{1}{2}$ in. dia. × $\frac{5}{8}$ in.

Wheels, Steering and Springing

The road wheels and flywheels are either gun-metal or bronze castings, with spokes nicely cleaned up by filing. The front wheels are mounted on a square section axle which is pivoted on a cast perch-bracket bolted to the underside of the boiler (Fig. 2). From the lower end of the perch-bracket a stout stay extends backwards to the firebox throat-plate, and between axle and bracket there is a strong coil-spring. Steering lock is controlled from a steering wheel which may be seen on the cover photograph of this issue, and Fig. 1, on the left-hand side of the firebox. The steering shaft is screwed, working in a nut pivoted at one end of the cast traverse lever which in turn is pivoted on a bracket bolted to the boiler shell, and connected to the front axle by means of the drag-link shown. Notice all the joints of this motion are secured by washers and tiny taper-pins typical of the thoroughness used throughout. (Fig. 2.)

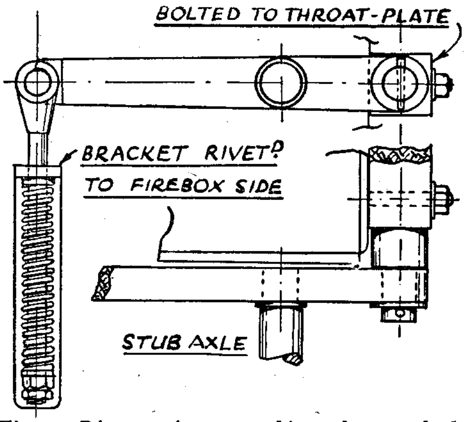


Fig. 3. Diagram (not to scale) to show method of springing hind wheels. See text

Also partly seen in Fig. 2 is the method of springing the hind wheels. Bolted to the throat-plate is a square bar with a spigot turned at each end. On these spigots are pivoted two levers which carry the stub-axles on which the hind wheels rotate, the levers being secured by washers and taper-pins again. From the hind end of each lever depends a hanger, which passes through a hole in an angle bracket riveted to the firebox. Below the bracket is a spring, secured by lock-nuts. (See also Fig. 3 and cover picture.)

Boiler and Fittings

The boiler is 4-in. diameter over lagging, and contains 47 copper tubes of ¼-in. inside diameter. The barrel is 7½-in. long, and the outer firebox 4½ in. long, 4¼ in. wide and 6¾ in. tall. The smokebox is 4⅝ in. diameter and 2½ in. long, wrapped from sheet and butt-jointed, with an internal patch lapped and riveted over the joint. The method of joining barrel to firebox and smokebox is not visible externally, because a very neat copper flange covers both these joints, but at the smokebox end it appears as follows :—The smokebox tubeplate is definitely riveted and soft-soldered to the smokebox (see Fig. 4) having a forward facing flange for that purpose. Then the boiler barrel is either flanged outwards, or has an external angle-ring fitted, which is riveted and presumably soldered to the tube-plate, as evidenced by the ring of rivets in the latter. I assume that the firebox end of the barrel is similarly flanged and riveted to the throatplate.

There are two longitudinal stays from tube-plate to backhead, and the usual stays at about ¾ in. centres in the sides, back, and front of the firebox, but I omitted to count the total number.

The firebox is arranged for solid fuel, with a cast-iron grate (lovely pattern-making, too!) but has never had a fire in it actually, so as not to spoil the showcase finish.

An inscription engraved on the smokebox door gives the builder's name with the dates 1893-1897, and bears the legends also "Tested with water pressure to 80 lb. per sq. in." and "Working pressure 30 lb per sq. in." The door is fastened by three dogs, and its hinge is filed from the solid. It closes against a flanged ring riveted in place.

Returning to the firebox, the foundation ring is ⅜ in. thick, and the sides and throatplate extend below this to hold the ashpan, which sits on flanges formed on them. (Fig. 2 again.) At the rear is a damper, which is controlled by the hind-wheel immediately below the footplate. As this is turned, a die-nut screwed on it lifts or lowers the damper through a link which can be seen in the cover photograph.

The firehole is a solid oval ring clamped and riveted between the plates of the inner and outer firebox. The door is of two thicknesses of 16 g. copper (to form the rebate), with hinges and catch filed to shape. The water gauge incorporates shut-off cocks in the top and bottom unions, and a blow-down cock in the bottom one. All the cocks, and the handles for the regulator, drain cocks, blower-valve, etc., have miniature turned hardwood handles, by the way.

A Salter-type safety-valve is mounted on top of the firebox, the spring being enclosed in a casing, as seen in Fig. 5 and on the cover.

The regulator-valve and governor-valve are fitted on top of the firebox, the handle for the former working in a quadrant. A whistle may also be seen in Fig. 6, but its handle is more clearly seen in Fig. 5.

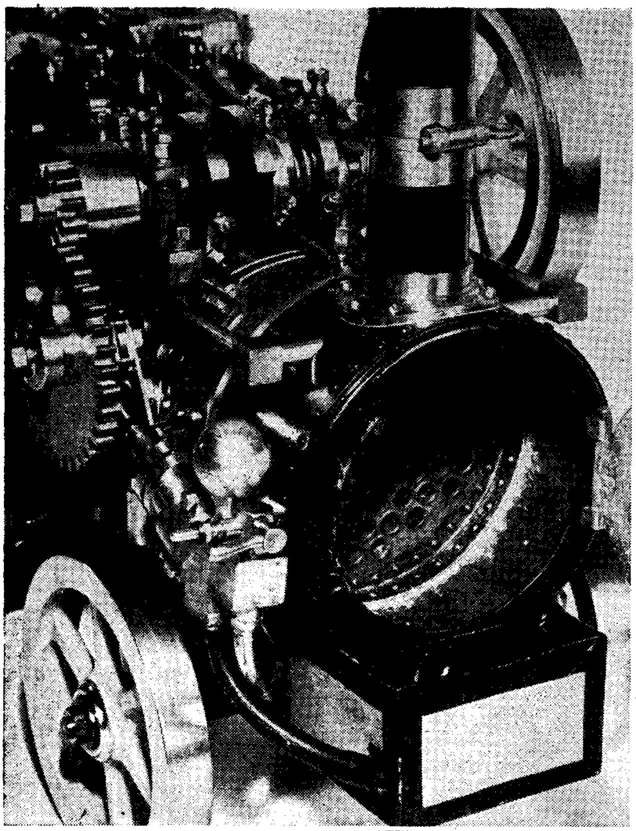
A gunmetal casting forms the footplate, which is supported on two brackets filed from the solid. Stanchions of steel have brass caps and feet, the rails being steel also.

The Engine and Motion

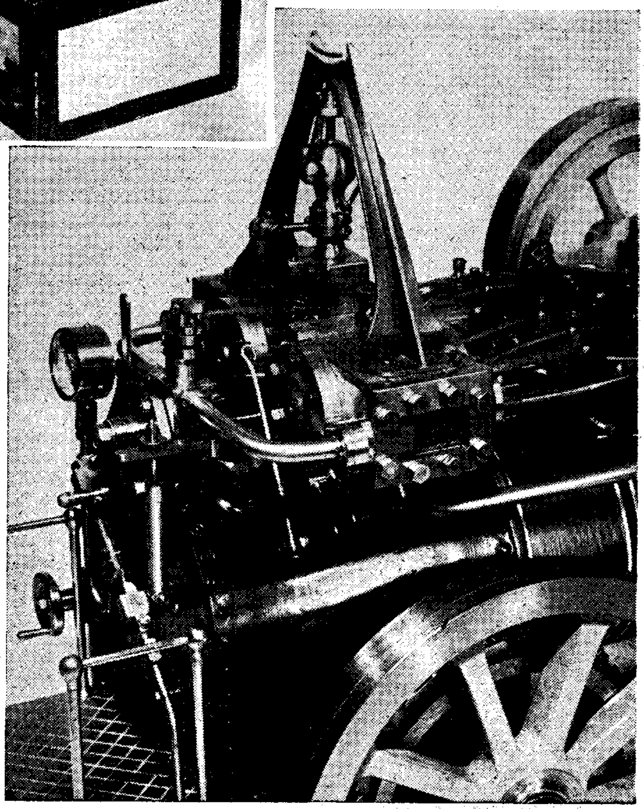
The engine itself is of the two-cylinder simple type—"double high pressure," as it was often called—the stroke being 1½ in. and the bore about ⅞ in.; we did not wish to remove a cylinder cover to verify the latter.

Each cylinder is a separate gunmetal casting fitted to the boiler on a curved saddle, and lagged with mahogany strips. Outside valve-chests are fed by steam from the regulator by twin external pipes, and the exhausts are led from the underneath along the top of the boiler barrel to the blast nozzle in the smokebox.

Girder-section slide bars are fitted, milled



Above—Fig. 4. *Pump, crankshaft, and smokebox. The four valve-gear eccentrics are arranged in pairs between cranks, with pulley for governor-drive between the pairs. Note beautifully shaped oil-cups provided for all frictional surfaces*



Right—Fig. 5. *Backhead fittings, regulator, governor, safety valve, and cylinders. Note linkage between governor and valve; also, control for blower valve and drain cocks, girder-section slide-bars, and valve rocker-arm*

from the solid, and supported at their outer ends by either cast or fabricated motion-brackets saddled and bolted to the boiler shell. (If cast, then both the pattern-making and foundry work were of the highest order; the finish is exceedingly high.)

Fork-type crossheads are fitted, and the connecting-rods have solid eye little-ends and marine-type big-ends. The latter are rather unusual for the type of model, and are possibly a result of the builder's naval connections *via* his firm. The rods are turned from the solid, including the big-ends, and have a nice taper and polish. Big-ends have split brasses, and caps secured by nuts and lock-nuts.

The crankshaft is another lovely bit of work, being apparently turned from the solid. Journals and crankpins are $\frac{5}{8}$-in. diameter, and the two throws are at 90 deg., as usual. The crankcheeks are so shaped as to provide balance weights as the photographs show. The shaft is carried in two cast-iron pedestal-type bearings, fitted with split brasses, and the caps lock-nutted. The bearings are themselves bolted to the two cast-iron brackets which are bolted to the boiler shell.

Between the cranks are two pairs of eccentrics for what appears at first sight to be Stephenson valve-gear. However, on closer inspection, it will be seen that the links are *not* curved, but straight, denoting Allen gear.

The eccentrics are of steel $1\frac{1}{8}$-in.

in diameter, with gunmetal sheaves, working central rocking levers to which the die blocks are attached. These levers are taper-pinned to shafts which are carried in bearings which project downwards from the lower slide-bars, and further rocking-levers are fitted to the outer ends of the shafts. These work the crossheads of the valve-rods direct, the holes in the crossheads being slightly slotted in the vertical direction to allow for the fact that the operating pin works on a radius. The valve crossheads are gunmetal, by the way.

In each of the inner rocker-arms, a stub-shaft is pinned, on which fits the die-block on which the links slide. The slots in these are apparently end-milled, and the steel eccentric-rods are pin-drilled at the ends to reduce their thickness in order to fit into milled slots in the ears of the links. The pins forming the joints are fixed by washer and taper-pin, as so often noted in this model. The other ends of the rods are brazed into slots in the eccentric sheaves. Valve travel is approximately ⅜ in. in full gear.

Working in a quadrant fixed by a cast bracket to the firebox, the reversing-lever is seen in Fig. 6. The spring-loaded latch (into which the handle is fitted) has a peg which fits into one or other of a series of holes drilled radially on the underside of the quadrant to vary the cut-off. The weighbar shaft is carried in a bracket bolted to the boiler top. Notice the reach-rod, by the by—a straight and parallel rod would have filled the bill, but it is typical of Capt. Tresidder's workmanship that it is filed to the fish-bellied shape shown, in order to present a better appearance.

Each cylinder has two drain cocks, which are coupled together and opened by one small wooden handle, which may be seen in Fig. 5. They discharge through 5/64 in. diameter pipe into the exhaust pipes. The other small handle close by, attached to rather a long stem, works a lever on the end of a long rod which goes right forward beneath the motion work to the blast cock, which is screwed direct into the top of the boiler right at the front. (See Fig. 4.) From the cock a ⅛-in. diameter pipe leads to the blower-jet in the chimney base.

The heavy cast gunmetal flywheel is fitted with a small knob close to the rim, which is very convenient to turn when one desires to watch the smooth and very pretty motion.

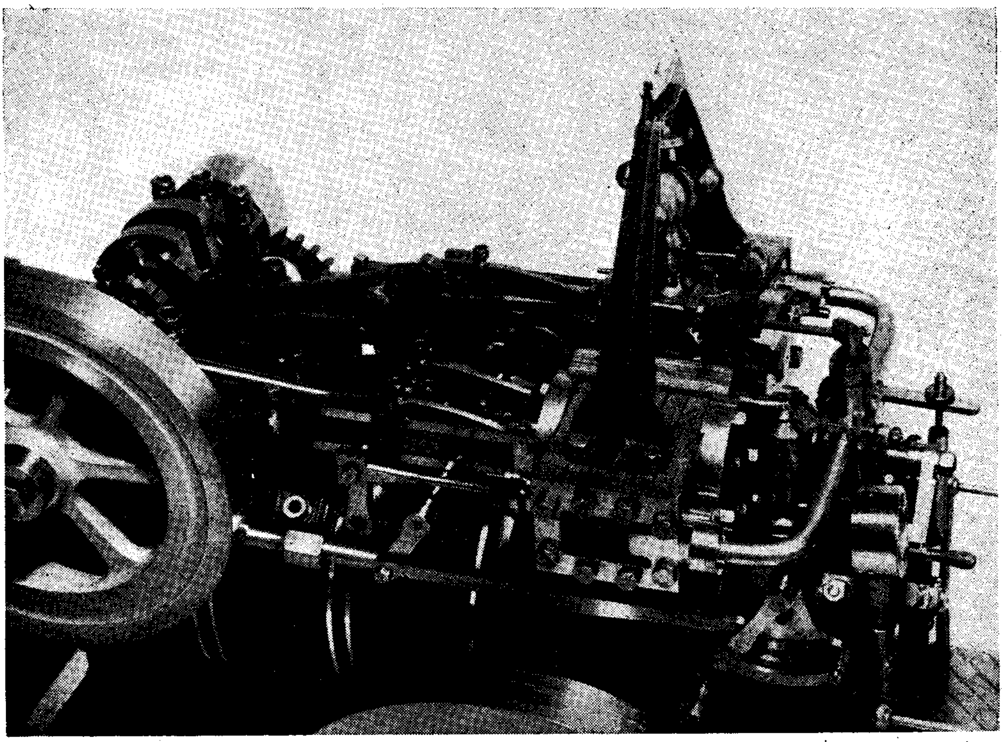


Fig. 6. General view of the motion. Note also jockey-pulley for governor belt, reversing-lever and reach-rod, and whistle

Governor, Pump and Chimney

A working governor is mounted on a stand which bridges across the space between the cylinders, and its top is supported by a bush fitted in the A-frame on which the chimney rests when down. (This frame, of tee-section throughout, is apparently silver-soldered up from brass sheet.)

Driven by a belt from a pulley between the two pairs of eccentrics, a 1-in. diameter bevel wheel drives another of $\frac{1}{2}$ in. diameter mounted on the vertical governor shaft. As the weights rise, a stirrup operates the governor-valve through a bell-crank and ordinary crank. This detail is well seen in Figs. 5 and 6.

A stub-shaft is fitted into the cast bracket which carries the right-hand bearing of the crankshaft and a spur-pinion on the latter drives a large spur-wheel on the stub-shaft, the first step in reducing the gear-ratio between engine and hind-wheel. But this reduction-gearing, which is 1 : 3, also serves another useful purpose, in reducing the speed of the water pump, for the eccentric for the latter is mounted on the boss of the large spur-wheel.

The pump itself is mounted by clamping it in a flange which is bolted to the side of the smoke-box. It feeds to a clack mounted on the side of the boiler, suction being *via* a rubber pipe from the water tank which is slung below the smoke-box. There is a surge-chamber on top of the clack-box, and a cock in front of this has a screwed spigot, which the present owner has fitted to enable a foot-pump to be connected in order to put pressure in the boiler and so work the engine. It seems likely that the original idea of this cock was to by-pass water to the tank. The trunk-type piston has a diameter of $\frac{3}{8}$ in. and stroke of $\frac{1}{2}$ in.

The chimney is $1\frac{1}{4}$ in. diameter with a shapely brass cap 1 in. diameter. It is hinged near the base—another indication of being based on early traction engine design—with the hinge and latch both filed from the solid. The base flange for attachment to the smokebox is also turned and filed to shape.

The Drive

As we have seen, the first reduction in drive ratio is by means of gears, and it will be noted that the pinion and spur-wheel are in constant mesh.

Final drive is to the right-hand hind wheel by pitch-chain, with a small sprocket mounted on the stub-shaft behind the spur-wheel (and incidentally, behind the pump-eccentric), and a large sprocket attached to the wheel. Obviously with a traction engine or road locomotive it is necessary to be able to run the engine free for driving machinery, without driving the hind-wheels, and in the model this is accomplished by means of a clutch. There are three pins set in the back of the pump-eccentric, and the chain-sprocket has three corresponding holes, thus forming a kind of dog-clutch. When the holes engage the pins, of course, the drive is taken, but when the sprocket is slid sideways on the stub shaft, the drive to hind wheel is disconnected. The sprocket may be retained in either of the two positions by one or other of two clutch-levers which engage with a recess turned in the boss of the sprocket.

The chain itself is beautifully made, with alternate hollow and solid links, as sketched. The sprockets also call for comment, as not only do they have a central row of teeth which engage with the hollow links, but two external rows of teeth which engage one each side with the gaps at each side of the solid link, between the ends of the external links. (See sketch.) A little thought will show that these sprockets are examples of nice machining, for the metal between the external rows of teeth had to be removed without interfering with the middle row of teeth, while the external surplus on the latter had to be machined away without touching the outer teeth. Turning being thus out of the question, it is assumed that end-milling was the method used.

Performance

As has been said, the engine is a "showcase" job, and has not had a fire in the box because of the risk of spoiling the paint. Nevertheless,

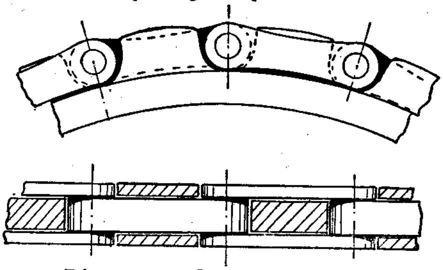


Fig. 7. Diagram to show arrangement of pitch-chain and teeth on sprockets. (*Teeth shown shaded in plan*)

it is a joy to watch the motion work running under compressed air. One way of "pumping up the boiler" is to put the motion in forward gear, with clutch engaged, and to push the engine backwards. When released, she will run forward again almost as far as she was pushed back, demonstrating that there is very little friction, yet that the pistons must be well-fitted and the valve-gear well set—for pushing the engine backwards obviously does not put *much* pressure in the boiler.

Alternatively, by means of the cock on the pump, previously mentioned, the boiler can be pressed to 20 or 30 p.s.i. with a foot-pump. The engine will then tick over slowly, in either direction, or on opening the regulator full, the rods and the flywheel spokes become a blur, if running with the clutch disengaged. The exhaust is healthy and free.

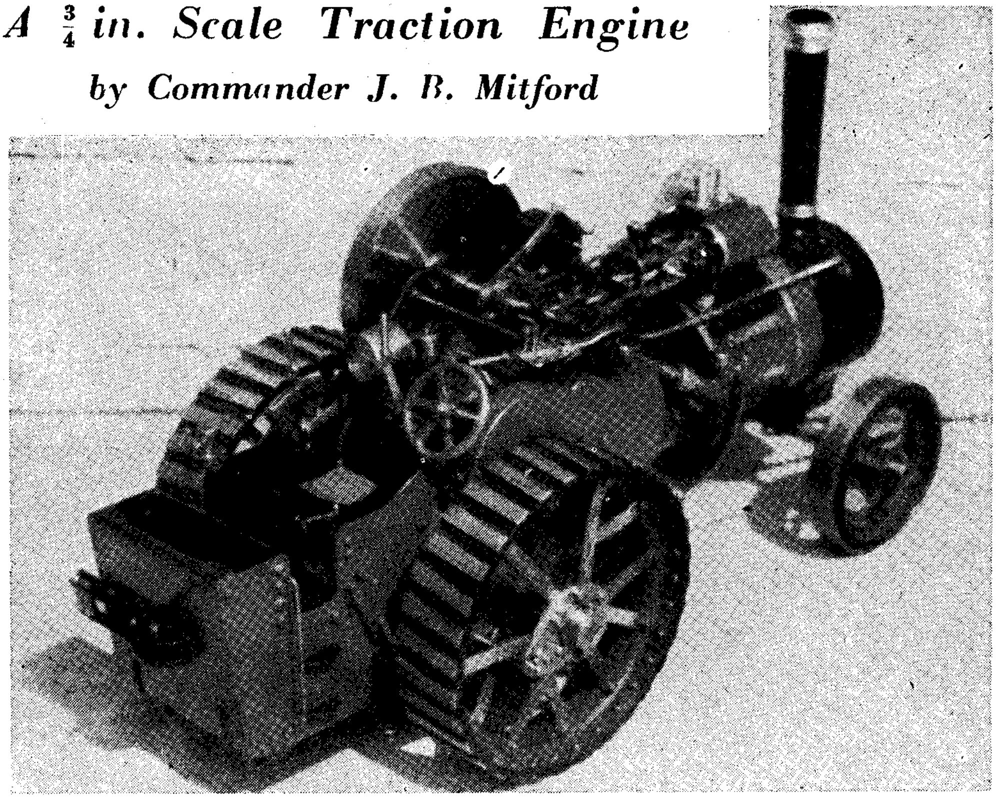
The model is very nicely finished in "exhibition" style, with not too high a polish on the steel, gunmetal, and brass surfaces; the boiler barrel is green, with black and white lining. Smokebox, chimney, and firebox are black, and wheel-spokes are an unusual creamy pink colour. Unfortunately, the smoothness of the paintwork does not show to advantage in the photographs, because floodlighting always grossly exaggerates the tiniest ripple on any photograph.

Normally, the engine is kept in a glass case on the owner's sideboard. It is a possession of which he is very proud indeed, and so would anyone be who is an advocate of that good, solid, beautiful craftsmanship which today is not seen as often as it might be in the world at large, but which is the aim of every right-thinking model engineer.

(*To be continued*)

A $\frac{3}{4}$ in. Scale Traction Engine

by Commander J. B. Mitford



THESE reproduced photographs of my traction engine may be of interest to readers who are held by the fascination of these most entertaining pieces of machinery. Back in 1936 a small picture was published of this engine, but a lot has happened to it since then.

It is based on some commercial castings and parts for a $\frac{3}{4}$-in. scale "Burrell" machine, but in the intervening years almost everything but the basic castings has been altered and chopped about to suit my fancy. To start off with I had no workshop, but a lot of good quality tools which had followed me about, some of them for years, and it was not until the engine had arrived at a very satisfactory steaming stage that I was able to come to anchor and buy a secondhand 3-in. treadle lathe. Finality has not yet been reached by any means, and the flywheel has already been carved into a proper six-spoked job, there being sufficient thickness of metal to allow for this in the plain turned one shown in the picture.

All the original work was done on borrowed machines whenever time and opportunity offered, and many a kind friend helped with one thing or another in this connection, and even turned bits and pieces for me on occasions. However, the hybrid is now almost all my own work, the latest contribution being a new chimney top with a more professional flare to it. The one shown came from the largest bit of scrap I could find in the box at that time.

Firing is by spirit, and is controlled by a long lever on the off-side behind the driving wheel. It works surprisingly well, and can be adjusted very finely, due to the great length of handle. I would not change it. The four large asbestos wicks can be run in a semi-starved state without burning as cotton ones would do, and therein lies one secret. Very much more steam can be made than can be used, another strong point.

It surprises me that the paint has never come off the outer casing of the boiler in spite of many accumulated hours of steaming. Perhaps it is because the flames get sucked along the bottom of the inner boiler drum by the blast, or some reason I have not fathomed out.

The valve-gear is Stephenson link, but owing to the very small dimensions and small link travel, the valve events are indeed peculiar, and might well confound the most expert of readers. I found that the astern eccentric needed an extraordinary advance of about 20 degrees, while the ahead one remained set at the usual 90 degrees. This arrangement, surprisingly, gives very even port openings both ahead and astern, except that the valve travel is much smaller overall when in 'stern gear. I have not tried to work out the whys and wherefores, but as one of the best known steam con-

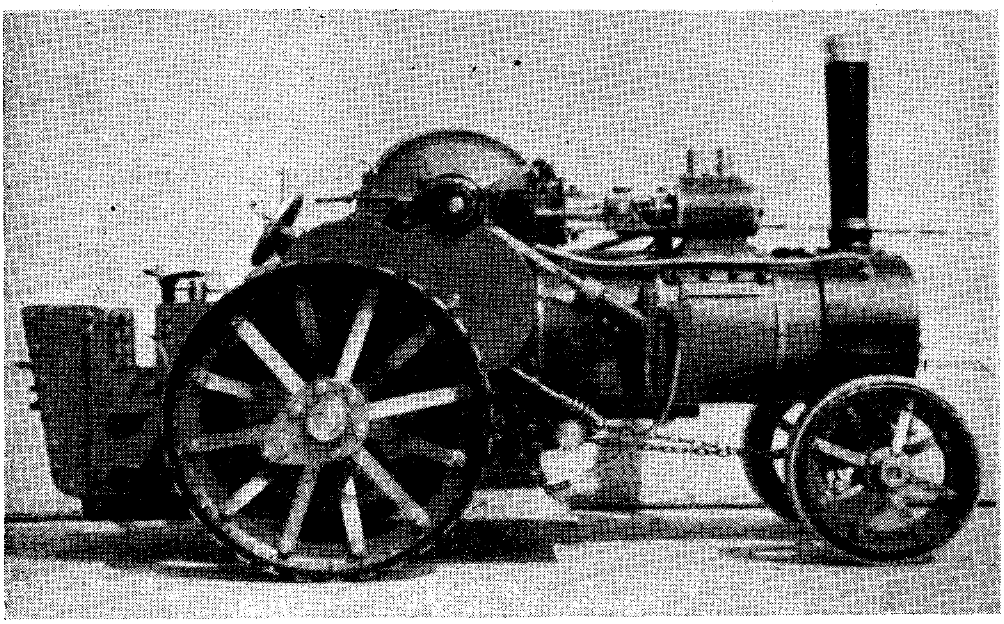
tributors would say, it's the results which count. Most likely a number of errors on my part even out to what is a perfectly satisfactory result.

An "L.B.S.C." type mechanical lubricator with a 3/32-in. plunger provides an excess of lubrication, so a small steel peg has been fitted to keep the "on" ratchet out of action unless required. In practice, an occasional turn of the ratchet wheel with the tip of one's finger does all that is required, and I think that the $\frac{1}{16}$-in. oil pipe from the lubricator to the steam chest acts as an efficient displacement lubricator, and one merely recharges this by the action mentioned above. Steam is not superheated at all.

The drive has no differential, as this presented too great a problem internally in the space available. Both wheels are driven, however, the near side one being driven through the medium of a jack-shaft passing under the foot-plate. Neither this arrangement nor any of the spirit-firing gear can be seen, even when inspecting the model closely, yet the spirit tank and burners can be slipped out in a matter of seconds.

The feed pump, like its brother the lubricator, supplies more than enough feed and spends most of its time bypassing the water back to the tank on the near side, keeping itself nice and cool in the meantime!

Backhead and cab fittings include throttle, blower valve, feed clack, pressure gauge, water gauge, feed bypass cock, reversing lever, crank-shaft pinion engaging lever, brake handle, steering wheel, coal bunker, coal door, and driver's seat. The brake works on the inside of the winding drum which is to be found inside the nearside driving wheel.



A lot of pleasure has been given to children and grown-ups alike on the many occasions on which I have had steam up in this little fellow, whose name is *Sandow*, incidentally, after an engine I knew and admired. The total length is 13 in., height 8 in. and diameter of driving wheels 5 in. He lives on the old oak chest at home, alongside my "L.B.S.C."-designed *Bury Grange*, and the pair of them come in for quite a lot of admiration while their constructor looks on with smug self-satisfaction!

I can recommend a model traction engine of this weight and size (I am not very sure what the weight actually is, but it is not much) to anybody who likes comparatively small models and is fond of "seeing all the works." The valve-gear is rather akin to clock-making, calls for good eyesight and nimble fingers, and if not well case-hardened in each moving part will wear out in a few runs. My first lot did this and I remade the whole outfit with more care and the above precaution.

Some constructional details may be of interest. The wheels are all built-up, the hubs being in three parts. The spokes are located in slots and gripped between the central slotted "cotton reel," and the outer and inner flange-pieces which spigot into the centre-piece form the axle bearings.

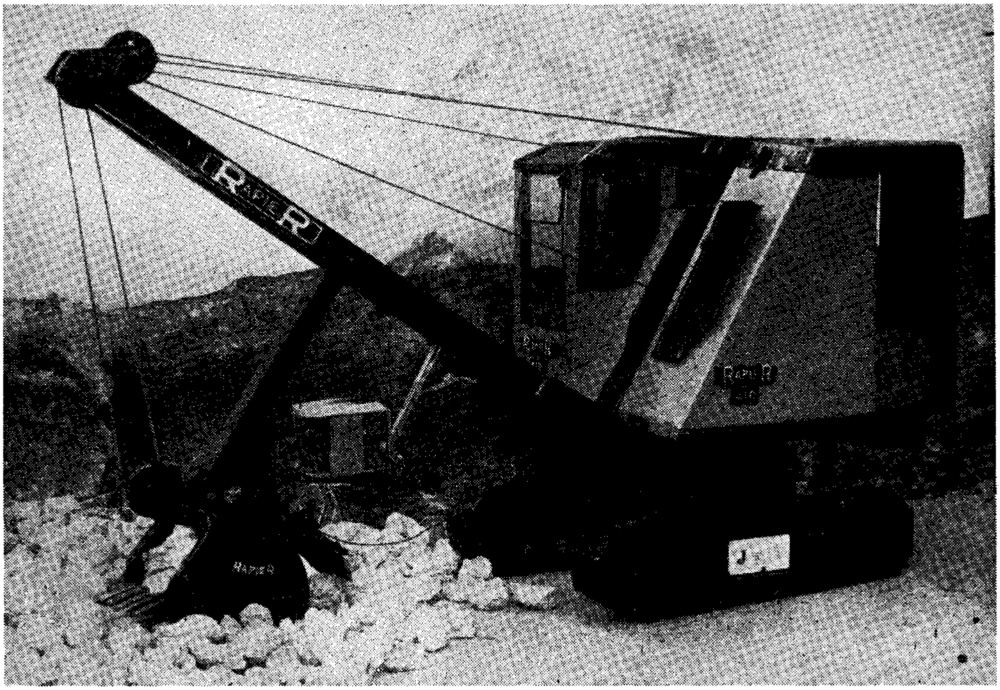
The connecting-rod and big-end bearing were copied from a derelict engine which I found in a Kentish orchard, its boiler then supplying some very low pressure steam to a lot of greenhouses. The rod is round, with a rectangular block towards the big-end, through which bolt the

(*Continued on page* 826)

A Model Rapier "410" Excavator

by R. A. Rush

THE idea of building an excavator occurred to me in 1946, when, at the model engineer exhibition in Ipswich, I watched a scale model Rapier "W150" walking dragline at work. Fascinated by its actions I immediately decided to build a model of this type, but little did I realise the difficulties I would encounter.



I had only recently left school and was working in a foundry. My experience of metal work was nil, though I had made several solid scale model aircraft in wood.

Luckily I managed to see an excavator catalogue and decided to build a Rapier "410" excavator, a ⅜ cu. yd. machine which could be adapted for use as a crane, dragline, grab, shovel, trencher etc.

My first main task was to obtain drawings of the layout of the machine. This was accomplished and in due course work was commenced.

I soon discovered that the drawings I had were general arrangements and thus did not give enough dimensions or details of any particular parts. This meant finding an excavator and measuring the correct sizes of the pieces required and making up my own detail drawings.

It was not long before I realised that the hacksaw and file, which were my only metal-working tools, were inadequate and most of my scanty pocket money went towards new tools.

The sixty crawler-belt links were made from aluminium. After I had made a pattern from the sketches, filing the grooves and drilling the holes in each one took just over an hour.

The crawler side frames were soldered up from a syrup tin, my first attempt at soldering, and the rollers made of scrap brass and the driving and idling sprockets of cast gunmetal, which were then shaped by hand. It was whilst "truing up" one of these wheels that a local engineer came and had a look at the job. I was told, much to my disgust, "You can't make it that way, you need a lathe. Come over to mine and I'll show you how it should be done."

As I had only a hand drill and no lathe, I decided to see how it should be done and after being shown (it is quite easy), I promptly made a mess of my castings and had to cast another batch.

This time success crowned my efforts and I decided to save up for a lathe.

The crawler-belt links fitted together very well and for a time all went smoothly.

Whilst searching the scrap heap I found an old lathe wheel which I machined to the size of the rotate rack—a pinion had to be made to mesh for slewing, and this was achieved only

after two attempts. The superstructure frame was supported with channels underneath, as in actual practice and revolves on four rollers running on the rotate gear wheel. The boom (or jib) was soldered from two brass channels having two home-made tin channels between them.

During odd hours I "borrowed" the lathe to turn up pulley wheels and shafts, dog clutches and bearings.

One of the most interesting parts was the bucket which was prefabricated from three pieces of mild-steel and welded together. After quite a bit of trouble and much scheming I managed to get both the rear and bottom doors of the bucket to open and close automatically.

The house itself was a complicated piece of bending and riveting, which had to be carried out very accurately.

It was here that I made a big mistake. I used sheet aluminium instead of sheet tin and spent many hours before any satisfactorily soldered joints were obtained.

The windows and doors, including the two curved doors at the rear were all made to open and close realistically (occasionally sticking).

At this stage I got thoroughly browned off with the model and so decided to make a travelling case.

I managed to obtain some Canadian cedar and set to work tongue-and-grooving, until, in the end, I had a box, on the lid of which the model had plenty of room to perform its cycle of operations.

A "skyscape" was painted on to a piece of hard board and three photographs of the actual digger pasted on to this background.

Work was then continued on the model. An electric motor of correct dimension was "salvaged" from an old hairdryer, mended, and has given good service ever since.

The primary speed reduction unit had to be made up from "Meccano" gears, as I hadn't sufficient time to spare.

The friction type reversing clutches were made in the same manner as the real job, but as I allowed only 0.003 in. clearance, any grit or oil tends to bind the clutch.

Barrels are operated by servo type clutches and with the brake bands are all operated by the correct levers in the cab.

And so, after 3½ years and 1,200 hours' work the model Rapier "410" excavator has been passed as "fit for service," and has since worked six hours at a time non-stop—with the exception of an oil for the model and a cup of tea for the operator.

A $\frac{3}{4}$ in. Scale Traction Engine

(*Continued from page* 824)

horns of a steel U-strap. A taper cotter through the bottom end of this strap closes the bottom brass, while the cotter and bolt, respectively, keep the brasses in correct location, being recessed into them slightly. This arrangement took my fancy, so it was copied.

The crosshead is of the box type, copied from yet another old engine in Kent, the cheek-plates of which are held by through-bolts to a gunmetal centre which in turn bears against the guide bars.

The cylinder, originally part of a stationary engine, was very much cut about and altered. The trunk guide was cut off and silver-steel guide-bars fitted instead. The bore was enlarged (quite unnecessarily it turned out) and the ports and steamways enlarged a little.

The pop-type safety-valve is located on top of the backhead instead of behind the chimney, where it looked out of place, as first fitted. The Ramsbottom valves on the cylinder top are dummies. The boiler has five $\frac{3}{16}$ in. water-tubes and a cast wet backhead, all fitting inside the outer casing with a suitable space between. The boiler is all silver-soldered and the steam and water pipe work all soft-soldered.

The crankshaft was built up and brazed, the shaft and crankpin being of $\frac{1}{4}$-in. mild-steel. The unwanted piece of shaft was cut out with a saw after the brazing. Steel $\frac{1}{16}$-in. pins were afterwards squeezed through holes drilled through the crank cheeks, but I now think perhaps this manoeuvre weakened rather than strengthened the job.

The steering consists of a worm cut for me by a Naval apprentice, engaging with an ex-gramophone wormwheel and shaft. The chains are ex-Swiss wall-clock.

All the driving gears were with the original bought parts. They give a reduction of 26 to 1 which works out very well and gives quite the right big engine effect. The gearing is all protected by covers made up from sheet brass with a few rivets and some careful soldering, the result looking quite good.

To raise steam, all that one has to do after filling the various containers with the appropriate liquids is to open the front door of the boiler (and of the house if indoors at the time!), light the burners, set the fuel lever to a position found by previous experience, and wait till there is enough steam to get the engine's own blower whiffling. Then shut the door and full steam will be available in a few more minutes. A few turns with the drive disengaged are all that is required before clutching up, then off we go. The record run was for some minutes over the half hour when spirit and water more or less ran out together. Experience shows that if the boiler is inadvertently allowed to run dry, nothing melts, and no harm comes to anything or anybody.

I see no reason why this model should not have a coal-fired boiler fitted without altering the size at all. After reading the notes on boiler making in THE MODEL ENGINEER for the past forty years, with breaks, and the past fifteen years, without breaks, I feel quite capable of getting out a suitable design and subsequently constructing it. With plenty of room available, as there is, for a decent sized firebox, I believe that the length of run on one firing would be considerable. I do not seem to remember seeing any account of a coal-fired traction engine as small as this in THE MODEL ENGINEER.

Novices' Corner

Making D-Bits

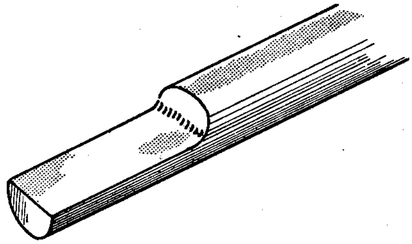


Fig. 1 *The D-bit*

THOSE who have attempted to drill a small hole accurately to size in work mounted on the lathe mandrel will often have been disappointed with the result when an ordinary twist drill is employed by gripping it in the tailstock chuck. However, the deeper the hole the less is the certainty that the drill will follow a true axial path. It often happens that as the drill penetrates deeply into the work it gradually develops a wobble, which becomes more pronounced the farther it goes.

This is quite understandable, for a small twist drill, has but little inherent rigidity and does not obtain accurate guidance from the bore formed; furthermore, unless the cutting edges of the drill's point are ground to a high degree of accuracy, the drill will tend to wander from the true drilling axis.

Fortunately, these difficulties can easily be overcome by using a D-bit whenever it is essential that the bore should be straight and exactly to the required size.

As will be seen from the illustration, Fig. 1, the tool consists of a cylindrical shaft which is made the size of the hole it is desired to form; one end is then cut to approximately the half-diameter so as to produce a D-shape when viewed in cross section. It is, of course, from this appearance of the cutting end that the bit gets its name.

To allow the tool to advance without rubbing against the bottom of the bore, the cutting edge is relieved at an angle of 5 degrees, as shown in Fig. 2, in addition, the extreme tip is stoned with a hand stone to produce a slightly rounded corner.

The upper surface of the bit where the cutting edge is formed is not exactly on the centre-line of the shank, but is set above this line by an amount varying with the diameter of the bit. An allowance *X* of 0.001 in. for each 1/10 in. of the tool's diameter is usually adopted. Thus a ½-in. D-bit would have the flat surface at and behind the cutting edge 0.005 in. above the centre-line.

The smaller sizes of D-bits can be used without first drilling a pilot hole of rather less diameter than the finished bore. When boring with bits above ¼ in. diameter, however, it will save time if the bore is formed with a twist drill, but sufficient metal must be left to allow the D-bit to finish the hole correctly. A drill ⅛-in. smaller in diameter than the D-bit will generally serve, as this provides sufficient latitude for the final correction of any errors which may have arisen during the drilling operation.

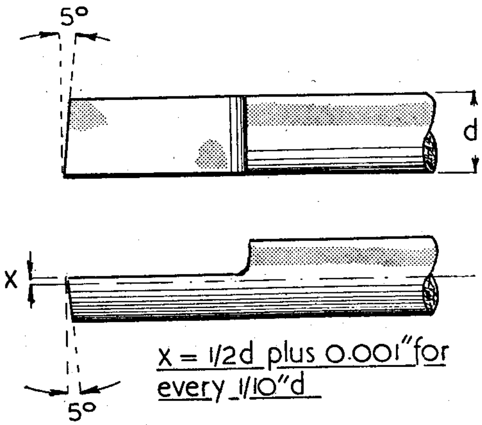


Fig. 2 *The proportions of a D-bit*

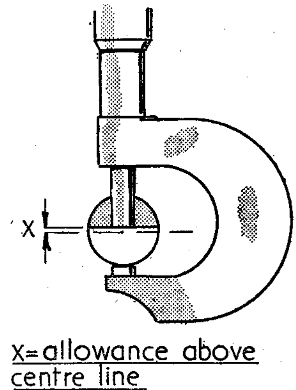


Fig 3. *Measuring the D-bit*

Making D-Bits

Although D-bits can be bought from the tool merchant, it is, as a rule, better to make them as required from bright silver-steel rod. There is nothing difficult about this, for the one possible difficulty, that of measuring the cross sectional dimension of the flat surface behind the cutting edge is readily met by taking a direct micrometer reading, as shown in Fig. 3.

When making small bits, the surplus metal should be removed with a file only ; but, when large bits are being shaped, it will save time if the bulk of the metal is first removed with a hacksaw. Care must be taken, however, to ensure that enough material is left to enable the upper surface later to be filed to size.

Except on large bits, there is no need, at this stage, to form the relief angle on the cutting edge, for this is best carried out later by grinding.

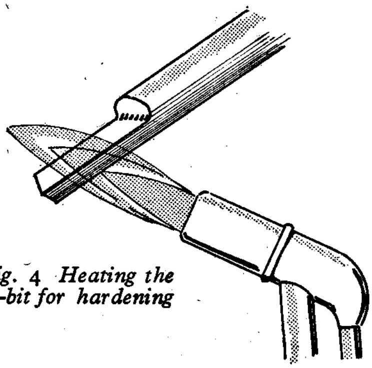


Fig. 4 Heating the D-bit for hardening

Hardening and Tempering the D-Bit

The tool must now be hardened and tempered. This is work which has been described many times, but, as it is the key to the making of a successful D-bit or, indeed, any other cutting tool, no apology is offered for repeating the instructions.

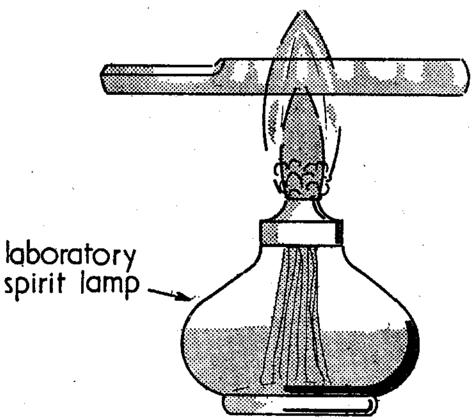


Fig. 5 Tempering the D-bit

To harden the tip of the tool, the end of the bit is first heated to a cherry red-heat and then plunged into cold water. As it is necessary for the hardening to extend for only a short distance behind the cutting edge, the end portion only of the tool is heated and the flame should be directed towards the cutting edge of the tool, as shown in Fig. 4. For the sake of clarity, the flame, in this illustration, has been shown playing directly upon the D-bit. In practice, the metal should be protected from the direct heat of the flame by using asbestos cubes or pieces of fire-brick, otherwise the edge of the tool may become burnt and will then fail to stand up to its work.

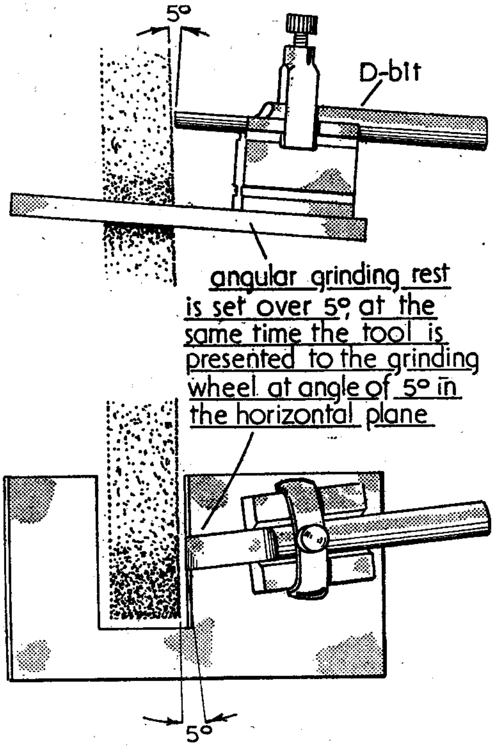


Fig. 6 Grinding the D-bit

Heating to an excessive temperature will tend to weaken the bit at the point where the flat surface joins the shank, and will also destroy the composition of the steel on which the cutting qualities depend.

If a carbon or silver-steel tool is heated to a yellow-red-heat, a higher temperature than cherry-red, and is then plunged into cold water, cracks, which result from uneven quenching, are likely to develop. On the other hand, and provided the carbon steel is of good quality, the tool may be quenched *in oil* without this trouble occurring.

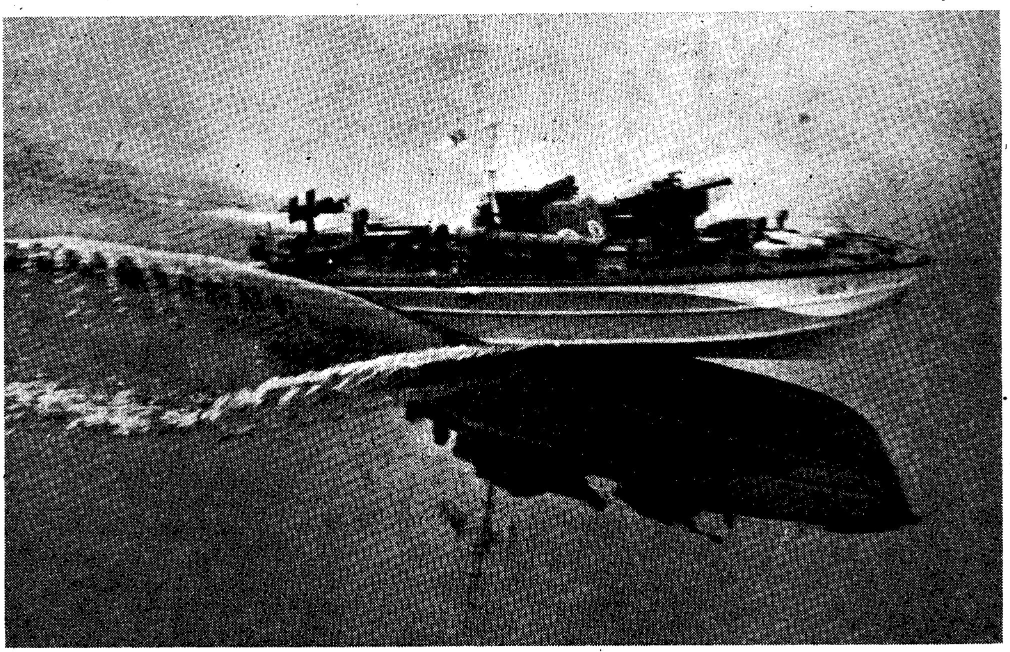
It should be mentioned that the hardening of the steel is the result of a metallurgical change

(*Continued on page* 833)

Experiments with Radio-Controlled Model Boats

by Harvey A. Adam

THIS account of my experiments and trials with radio-controlled model boats is rather in the nature of an interim report, for my whole aim in carrying out the lengthy and arduous runs during the past two years has been to test boats, engines, and radio equipment, and find the most suitable combination with which to make an attempt on the Channel crossing from Dover to Calais.



A 35½ in. scale model British power boat, M.T.B., travelling at 20 m.p.h.

During the course of these trials, runs of over 30 miles have been made, and durations of up to 3 hours sustained continuously, and I feel this short report may be of interest to readers who are experimenting in this field.

Some years ago I was told by a friend and colleague, Mr. S. N. Barker, then managing director of the British Power Boat Co., that the first thing to consider when planning a project, is the end of the job, or, in other words, know exactly what you want the finished product to achieve, the conditions that may affect this, and the qualities that will be needed to counter them.

Adopting this advice, I found the following summary of considerable value in keeping the main problems to be overcome in view.

(1) The boat would have to complete at least 25 miles non-stop in probably rough and windy conditions.

(2) The boat would have to be held on a straight course, in spite of head or beam winds.

(3) To battle through rough seas, the boat would have to be both powerful, and fast (at least 10 m.p.h.).

With these essential points in front of me, I then settled down to solving them.

I would stress here that the radio control of model boats in the open sea is a vastly different proposition to the operation of a barely moving electrically-propelled model on an ornamental lake.

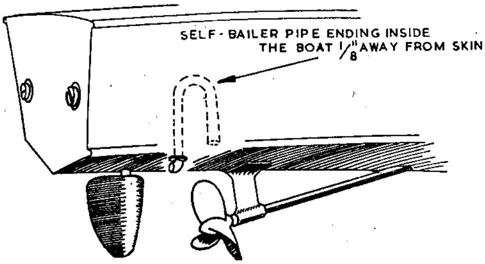
Briefly, I would need to design a hull to carry not only the fuel for the trip, but the radio equipment necessary for holding her on course, and fitted with an engine or engines of sufficient power and dependability to maintain at least 10 m.p.h. for 3 hours' continuous running.

As I had in the past had considerable experience in building and operating model boats in the open sea, I had already arrived at some definite conclusions regarding the type of hull, and engines to be used.

I had found that by far and away the most

suitable type of boat for rough sea work, was the hard-chine, V-bottomed, semi-planing craft, and having decided that my model would have to be between 50 in. and 60 in. long, chose for the actual crossing a scale model of the 115 ft. "D" class Fairmile M.T.B., a ½ in. to 1 ft. model giving a length of 57 in. with a beam of 11 in.

Exhaustive tests on a wide variety of 10 c.c. petrol motors had shown that the so called "hot" motors were of little use in general purpose boats,



The automatic self-bailer

owing to their dependence on extremely high r.p.m. for their power, and as I am firmly of the opinion that propeller speed should be kept below 5,000 r.p.m., and lower if possible to give the greatest efficiency, my final choice was reduced to three; the 10 c.c. twin plug Cyclone, the 10 c.c. Brown Junior, and the Ohlsson "60."

Of these the Cyclone had the advantage of an ignition flexibility which permitted a reduction in speed under load from 4,500 r.p.m. to just under 1,000 r.p.m. without affecting the induction.

At this stage I had not considered any alternative power units, so decided to carry out a series of engine and radio-control endurance trials in an existing model I had available.

This was a 35½ in. scale model of the 71 ft. 6 in. British Power Boat M.T.B. which weighed 7½ lb. without radio-control equipment, and when fitted with the dual plug Cyclone was capable of 20 m.p.h.

It was equipped with a single balanced rudder, and already had self bailer fitted. This last accessory is a U-shaped piece of pipe, so arranged that one end protrudes through the bottom skin of the boat, and the powerful suction of the slipstream at this open end removes any water that may have collected in the bilges.

Before fitting the radio control, I wanted to obtain some data regarding rudder settings required for straight running, so adjusting the timer to give 5 minutes' running time, or just under half a mile distance, I carried out a number of steering checks.

I found that in calm sea with no wind at all, a rudder setting of 7 deg. to port was required to overcome propeller torque, and maintain a straight course.

With a strong wind on the port beam a correction of 20 deg. was required, and in the same conditions a setting of 35 deg. was needed before the craft would turn strongly into wind.

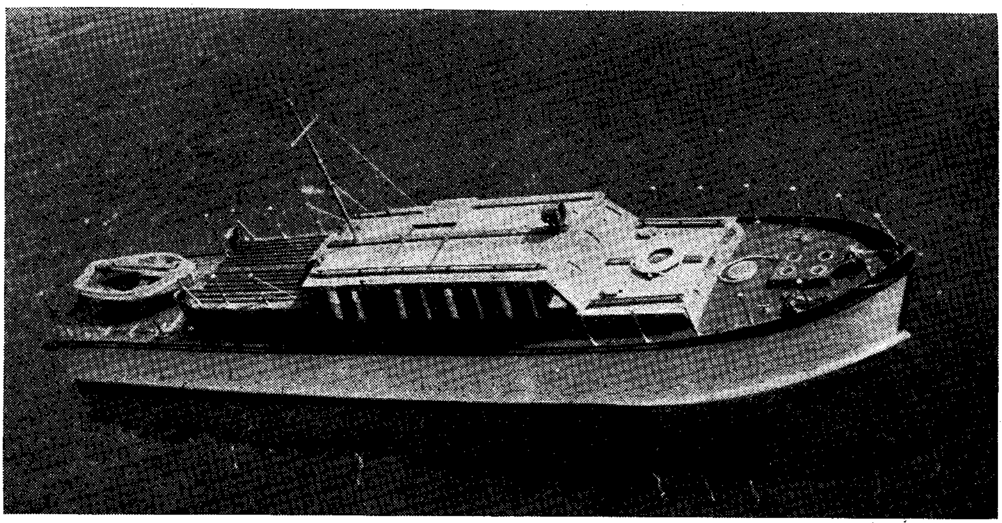
I decided, therefore, to allow a rudder movement of 45 deg. to port and 35 deg. to starboard for radio control operation.

I had also confirmed the need for an engine speed control, for on several occasions in rough seas the whole boat had left the water.

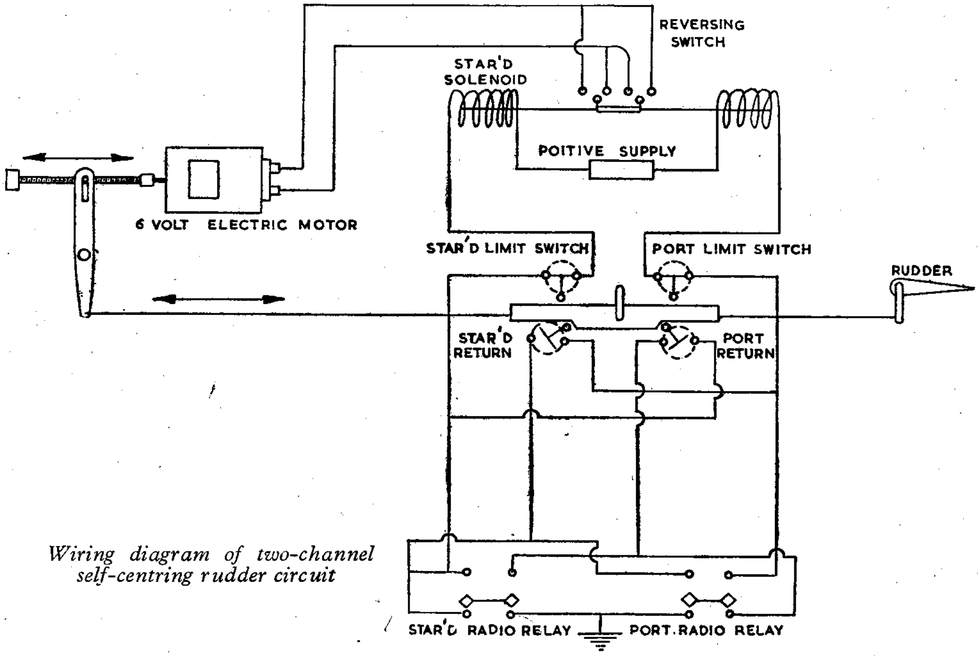
I was now ready to install the radio control unit, and had decided that the E.D. set would be the first to undergo extended trials.

Unfortunately I wasted considerable time, because I accepted the manufacturers' assurance that their servo actuator would work the rudder by direct link..

Let me make this quite clear, I intend no criticism of the E.D. set; it is very good, but it is quite impossible to operate the rudder of a fast



The 47 in. cabin cruiser, "Fairlie Bluff," fitted with twin 2.4 Mills engines. Range 35 miles



Wiring diagram of two-channel self-centring rudder circuit

moving, and powerful boat with an actuator depending on a relay escapement.

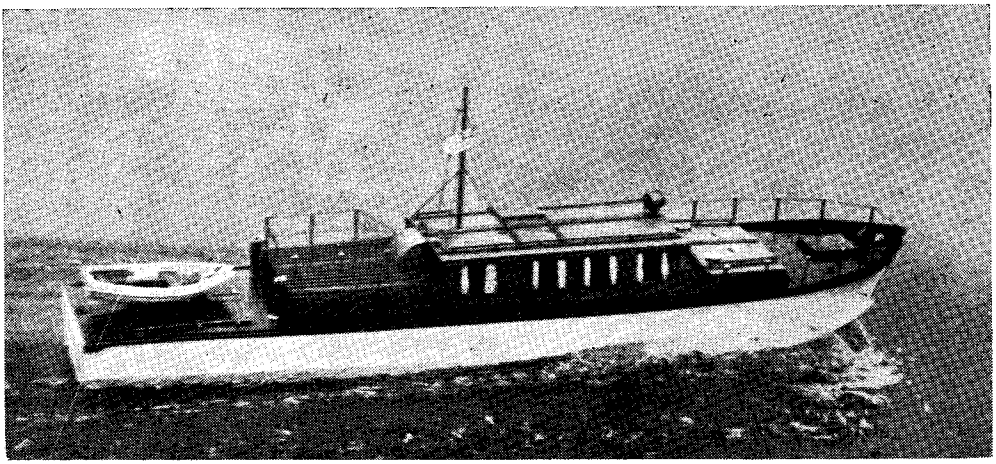
An electric motor governed through switches by the actuator, is in my opinion the best solution.

What actually happened in practice was this; the boat, if fitted with a balanced rudder, when given either port or starboard signal, would, because of sudden application of *full* helm, go into a violent skid, and then recovering from this, continue to circle regardless of the further signals received.

If fitted with an unbalanced rudder, release of the escapement merely allowed the rudder to centre from the 7 deg. bias, and permitted the boat to turn gently to starboard.

While carrying out these tests, I was given the opportunity of trying the American Bell radio control unit, and though not providing the ultimate solution of my own problems, it has many features that are ideal for the operation of fast marine models in restricted waters.

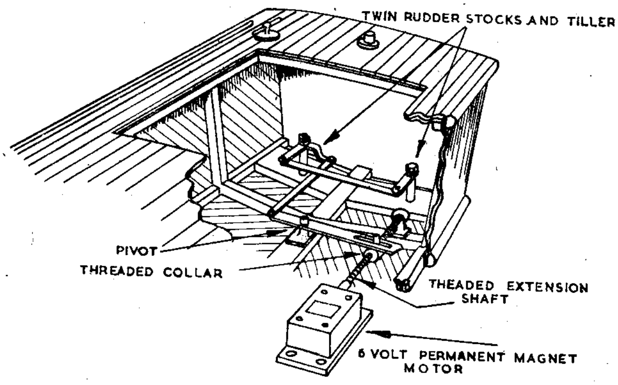
Because it is a two-channel receiver complete with electric servo motor, and self-centring switch, the snags of sequential operation of the



The 47 in. cabin cruiser at speed

rudder are avoided, and whatever helm is required can be given instantly.

In operation, if the two-way transmitter switch is given port or starboard helm, a pulse or tone signal is transmitted which, when received through the appropriate channel, operates the relays, closing the port or starboard circuit of the servo motor.



The steering gear in "Fairlie Bluff"

However, the first open sea run provided conditions where a beam wind called for almost continuous signalling to maintain a a straight course, and it became apparent that the self-centring switch would have to be scrapped to allow the rudder to be left in any position for long periods of the cruise.

This moves the rudder smoothly over to full helm, where it is switched off by limit switches.

Release of the transmitter switch closes a return circuit, and the rudder is centred automatically.

A study of the simple wiring diagram shows how this is effected.

It will be noted that if only a little helm is required to correct the boat's course, a momentary application of the transmitter switch will give this, and immediately centre the rudder on release.

This unit was installed in a 40 in. scale model of the 80 ft. American P.T. boat also driven by a 10 c.c. Cyclone engine. A photograph of this model was published on page 34 in the March, 1949, issue of *Model Ships and Power Boats.*

The all-up weight of this boat was 14 lb., and her maximum speed was 15 m.p.h.

On trials in a large lake this combination seemed to be the answer, and with the transmitter raised some 5 ft. above the water level, it was possible to navigate with accuracy the whole of its 900 yd. by 120 yd.

With the switch removed, I then carried out a series of long-distance runs with complete satisfaction, and a few details of these may be of interest to the reader.

(1) Lymington to Yarmouth and back non-stop, 8 miles at an average speed of 14 m.p.h.

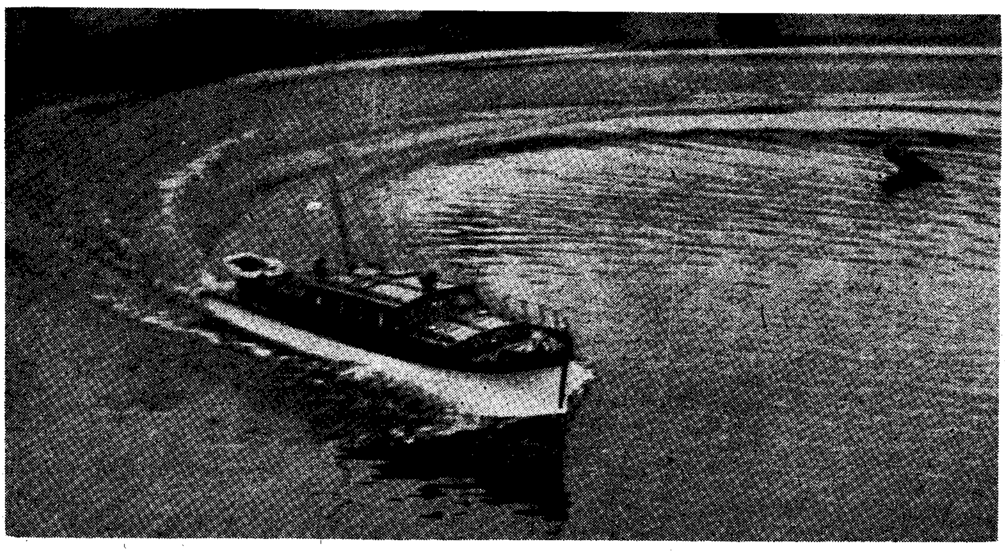
(2) Jack in the Basket, Lymington, to the Needles and back non-stop, 14 miles in 1 hour 7 minutes.

(3) Jack in the Basket to Calshot Light and back non-stop, 22 miles in 2 hours 10 minutes. (L.T. accumulator lead worked loose and gave intermittent trouble throughout run.)

(4) Jack in the Basket to Hythe, 18 miles in 1 hour 9 minutes. (Ignition accumulators broke adrift after hitting a tug's wash, and prevented the return journey.)

A number of other troubles due to batteries or accumulators running low prevented other runs being completed, but during the two months of severe testing, no trouble was experienced with hull, engine, or radio control unit.

I would add that the transmitter was operated



The cabin cruiser "Fairlie Bluff" coming out of full port helm on radio control

from the forward deck of a 41 ft. 6 in. *ex*-R.A.F. seaplane tender.

I had in the meantime installed a Mercury receiver, and actuator in a 47 in. cabin cruiser, engined with two 2.4 c.c. Mills diesel motors installed side by side and coupled behind centrifugal clutches with an idler gear driving the cooling fan. Although not a fast boat, having a full speed of only 10 m.p.h., the additional space allowed me to use larger accumulators, and batteries, and carry enough fuel for 3 hours' running.

This model was fitted with twin rudders, and as they are both out of the slipstream of the propeller, reduced the amount of helm required for straight running to 3 deg.

Though I did find it possible to work the rudders directly from the servo actuator, the need for keeping any degree of helm on for long periods, made it necessary to have an electric motor for their operation, and I therefore fitted a standard Adamcraft motor to which I added a threaded shaft extension.

On this extension was a threaded collar attached through a lever to the rudders. Governing the direction of the motor I installed a reversing switch worked by mechanical link from the very nicely made eight-stage sequential actuator.

By coupling a bimetal delay switch to a solenoid, operated by one of the neutral stages between port and starboard sequences, I was able to stop the engines.

Up to the present this model has completed two long-distance cruises with complete success, and apart from the need to remember at which sequence the actuator is resting, I find that navigation is as simple with this method as with the two-channel set.

Both trips were made on the same day, and consisted of the 32-mile journey from Lymington to Bosham in Chichester Harbour, and, after refuelling, the return trip.

Sea conditions were not good, but though the model took several green ones over the bows in the morning, her time for the outward trip was only 3½ hours.

In the afternoon the homeward run was made in 3 hours 22 minutes, and apart from having lost her dinghy overboard, was in first class condition.

These experiences in the sort of conditions I should be likely to meet during the attempt on the Channel crossing, together with the valuable data on engine behaviour, fuel consumption, etc., and the very dependable way the commercially-produced radio control units stand up to hard and gruelling work, convinces me that no real difficulties will be experienced in achieving my object.

In concluding this half-way report, I would like to summarise certain conclusions I have reached through these tests, that I think are worth noting by anyone contemplating the excitement and fascination of running radio controlled model boats on the wide open seas.

(1) Use a hull design that will lift over waves, rather than dig into them.

(2) Use a motor powerful enough to drive the model straight into wind.

(3) Keep air intakes and cooling ducts facing the opposite way to the direction of travel.

(4) See that batteries, accumulators, and all removable equipment are battened down securely.

(5) Check that batteries and accumulators are fully charged before any run.

(6) Make sure of all electrical connections.

(7) Fit self-bailers.

Making D-Bits

(*Continued from page* 828)

which takes place when the material is raised to a certain critical temperature. If the steel is allowed to cool slowly, it will revert to its original state, and will be soft. The quenching process, however, by rapidly cooling the steel, arrests this reversion and leaves the tool in the hardened condition.

It is most important to ensure that the quenching is as even as possible. This condition is best fulfilled by dipping tools, such as D-bits, lathe tools and the like, *vertically* in the coolant.

After the bit has been hardened it must be tempered to reduce the brittleness of the material and enable it to withstand the stresses imposed while cutting. In order to do this, the shank is first cleaned and polished with emery cloth and the flat surface brightened by stoning. Heat is then applied to the tool at some distance from the cutting edge in the manner shown in Fig. 5. A play of colours : yellow, brown and blue, will be seen to travel up the shaft. As soon as the cutting edge has reached the colour of light straw the heating should be discontinued and the tool plunged, immediately, into cold water.

Grinding the D-bit

The D-bit is most easily sharpened, after hardening, by clamping the shank in a V-block which is then placed on the angular grinding rest to enable the correct clearances, as illustrated in Fig. 2, to be formed at the cutting edge. On no account must the upper surface of the tool be ground, or the allowance above the centre-line which is given to this surface will be lost.

If reference is made to Fig. 6, it will be seen that the correct clearance for the cutting edge is a compound angle formed by presenting the tool to the grinding wheel at an angle of 5 degrees, in both the vertical and horizontal planes.

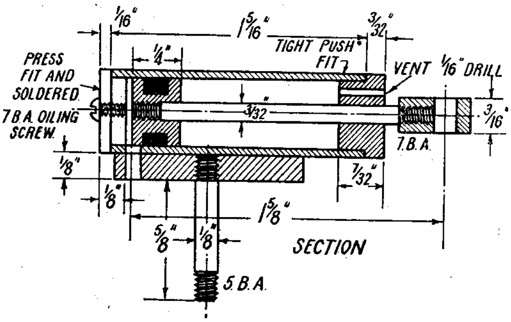
After grinding the front end of the tool, the upper surface should be lightly stoned to remove any burrs formed by the grinding operation.

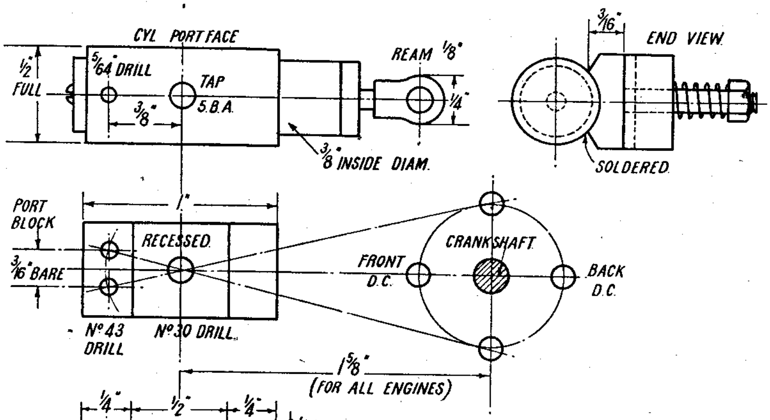
The procedure described above must also be followed rigidly when it is desired to re-sharpen the tool.

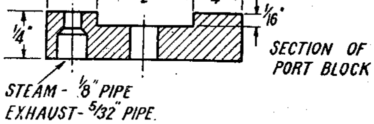
SOMETHING FOR THE KIDDIES

by "L.B.S.C."

CIRCUMSTANCES over which I have no control, have prevented my getting out the design for a kiddy's hot-air operated "diesel" shunting locomotive in time to make one for a Christmas gift; it will have to appear later on, all being well. On looking through advertisements of toys in various journals, I was amazed to see the enormously inflated prices charged for modern versions of the toy steam engines that were sold in the days of my own childhood. For the sum of *one shilling* (and some retailers cut that to 10½d.) the following working steam engines could be purchased:—vertical engine with slide-valve cylinder; both vertical and horizontal engines with oscillating cylinder; portable, semi-portable, and undertype with oscillating cylinder. Steam tramway car, traction engine, steam roller, reversing crane, and a fire-engine that would "run by itself" as the kiddies said, and pump a stream of water three feet high! "Bob" was literally "your uncle" in those days, and a very benevolent uncle at that.





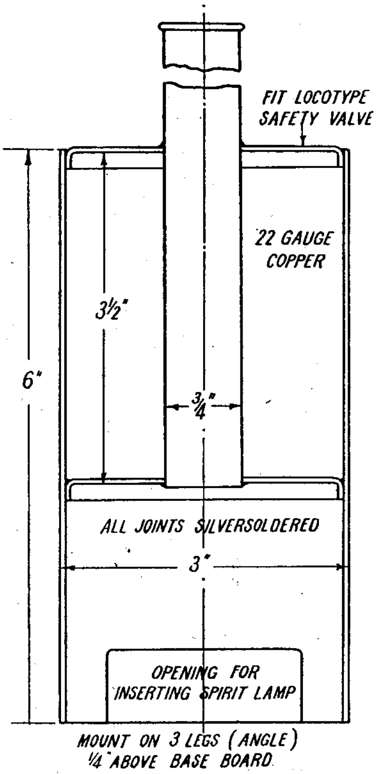


Details of Oscillating cylinder and port block

It occurred to me that if I gave a sketch of a simple oscillating cylinder and port block, any reader with a mechanically-minded kiddy could rig up something to please the kiddy in a matter of hours; so here are a few ideas. The cylinder is simply a bit of brass tube cut to dimensions shown, fitted with a piston, rod, push-in cylinder cover, big end, and a port block. The port face over which the cylinder operates, is a bit of flat brass with three holes in it, trued by rubbing on a flat file, same as our locomotive slide valves. A recess is filed across the trunnion hole, so that any slight burr around the trunnion pin, where it is screwed into the cylinder, won't affect the steam-tightness of the contact faces. The whole doings is merely a glorified version of the pump cylinder of my "standard" mechanical lubricator. To get correct steam distribution, all you do is to draw a line between the ports, and through the middle of the trunnion pin hole; the crankshaft is set on that line, the distance from the port block being arranged to suit length of piston-rod. With the cylinder made to the given dimensions, the distance from the centre of trunnion-pin hole to the centre of the crankshaft, should be 1⅝ in. on *any* engine to which the cylinder is fitted. A light spring and nut holds the cylinder steamtight against the port block, but leaves it free to oscillate.

Boilers

Two simple boilers are shown, each of which can be made in a single evening. The illustrations explain themselves. If thin copper tube of requisite diameter can be obtained for the shells, use it; thick stuff is no good with spirit-lamp firing. Otherwise, roll up the shells from 22- or 24-gauge sheet copper. The ends are flanged up from the same material, and all the joints are silver-soldered. As a matter of actual fact, soft-soldering is plenty strong enough for the low pressure used (the expensive toys mentioned



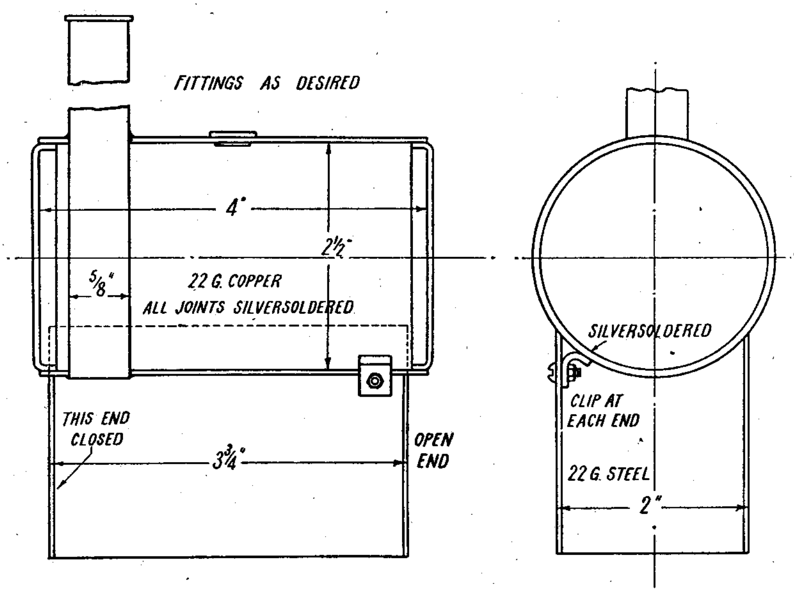
Vertical boiler

have soft-soldered boilers) but if silver-soldered, it doesn't matter a bean if the kiddy lets the boiler run dry. Put in ¼-in. × 40 bushes for safety-valve, steam valve and any other fittings you fancy. Most kiddies like a lot of "taps" to turn on and off!

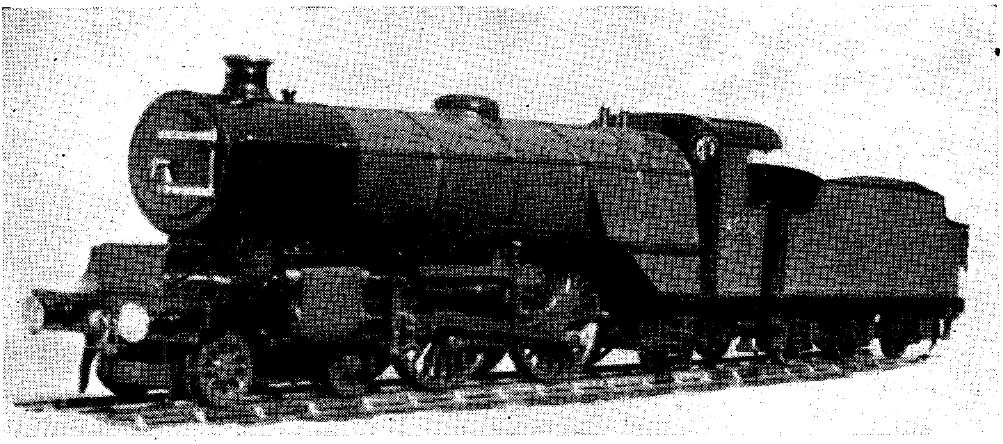
The "firebox" of the horizontal boiler is merely a bit of sheet iron or steel (even stout tin would do) cut to size shown, and bent channel-shape. When silver-soldering the boiler, four little copper clips can be attached to the underside; a $\frac{1}{16}$-in. screw in each will hold them whilst the job is in progress. Bend to the shape shown, and fix to the inner side of the firebox, by a screw and nut in each. A two-wick spirit lamp with a rectangular tank, tin for preference, as it doesn't get as hot as copper or brass, will provide plenty of "therms" for the horizontal boiler. A circular one with three smaller wicks arranged in a triangle, will do ditto for the vertical boiler. The exhaust steam from the engine should be turned up the chimney, to make plenty of draught for the spirit burners, which make a shocking smell if not properly ventilated. "Mum" will go off the deep end if it fumigates her curtains!

Types of Engines

A suggestion for a simple vertical stationary engine is shown in the accompanying illustration. The port block is attached to the side of the boiler by a small bracket, bent at right-angles at one end, and fixed to the port block by a couple of screws; the other end can be silver-soldered to the boiler. A $\frac{3}{16}$-in. crankshaft is carried in two sheet brass bearings attached to the firebox section of the boiler by screws and nuts. One end carries a disc crank with a ⅛-in. pin set ⅜-in. from centre, at the other end is a flywheel



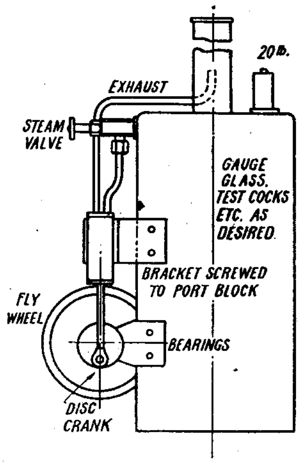
Horizontal boiler



Ten years' work by the Rev. G. S. Froggatt

and pulley. Steam is supplied by a screwdown valve, like a locomotive blower valve, and $\frac{1}{8}$-in. pipe. A small oil-cup can be attached to the steam pipe, close to the cylinder; with wet steam, very little lubrication is needed.

A semi-portable engine can be made by setting the cylinder horizontally, on top of the horizontal boiler ; if you turn the vertical illustration on its side, you will have the layout at a glance. The cylinder and flywheel can also be mounted on a separate stand, either a flat plate on four corner pillars, or a piece of sheet steel bent channel shape ; and either type of boiler can be used to drive it. There are several other variations in which a stationary engine can be made with the cylinder and boilers shown ; the important



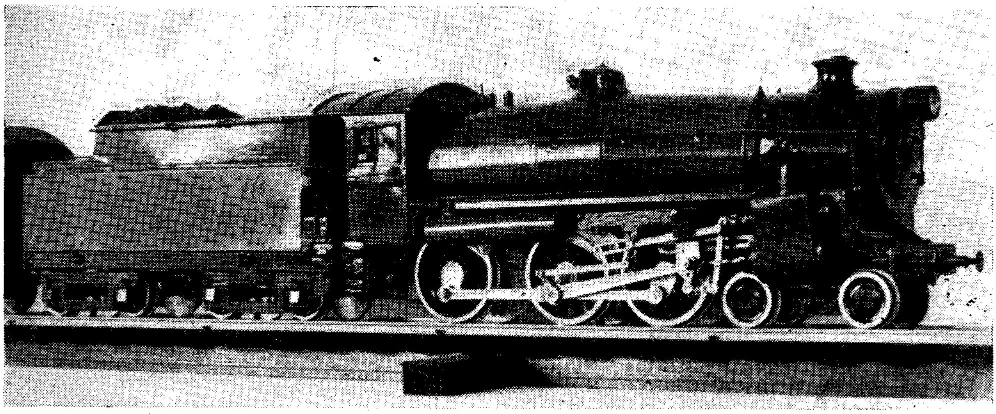
Simple steam engine

thing is, to keep the distance between trunnion-pin and crankshaft to the dimension given. All being well, I will give a few hints on the crane and fire-engine in the near future.

A Cab Query

Beginners often ask why, on a modern big-boilered locomotive, the driver couldn't be located at the front end, as on Milly-Amp and diesel engines. There are two objections ; firstly, it would be a dickens of a job to arrange regulator, reversing gear, and all the other blobs and gadgets, in a position ahead of the smoke-box ; secondly, it would separate the driver and fireman, and this isn't exactly conducive to safe and efficient operation. For quite a while, over in U.S.A., engines were built with the cab on top of the boiler, midway along the barrel ; there was a small auxiliary shelter (you couldn't call it a cab) at the firebox end, to afford some protection to the fireman. A footboard at each side, afforded communication between the cab and the tender ; the cab had back doors. These engines were known as "Mother Hubbards." There were several serious accidents, directly due to the amidships location of the cab. If a coupling-rod or connecting-rod broke on the right-hand side, which was the driving side, it demolished the cab ; and the unfortunate driver (or engineer, as our cousins call him) was either killed outright or badly injured. If a driver, leaning out, as many drivers do in all countries, was struck by a bridge, or something projecting from another train, the fireman wouldn't know anything was wrong until the train failed to stop at a station, or the brakes didn't go on when going down a grade. Anyway, the centre cab was finally condemned, and the rear cab standardised.

One railroad, the Southern Pacific, put the tender at the smokebox end, closed in the cab, and ran the engines with the cab leading. This was only possible because the engines were oil-fired, so it didn't matter which end of the engine was coupled to the tender. Naturally, it would not be possible on a coal-burner. Although the firebox and chimney were at the same end, on some engines of ancient days, like *Puffing Billy*, they couldn't be fitted the same way on a modern locomotive. However, the idea of putting the driver in front is, in a manner of speaking, as old as the hills. Way back in the mid-Victorian era, Michael Reynolds designed what he called a "saloon" locomotive. It was a single-wheeler, with the boiler and tender entirely enclosed, like a street tramway car.



Dr. Garth Mays' coal-fired "O" gauge engine

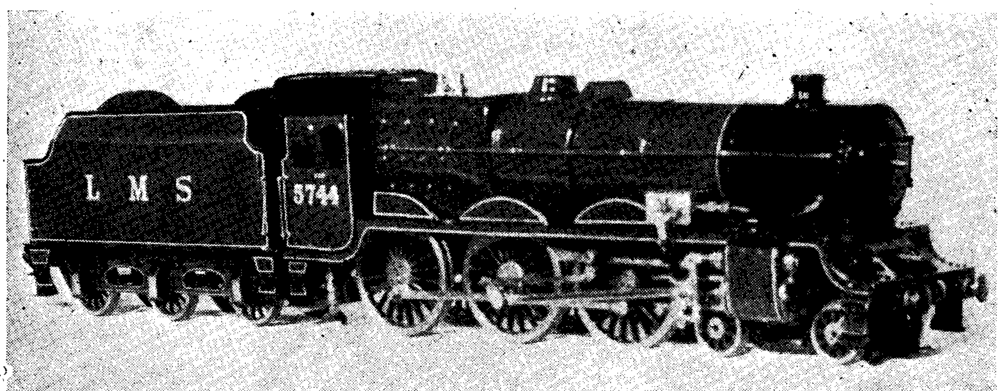
The driver was ahead of the smokebox, and the fireman at the back of the boiler, and there was plenty of space to walk along between the boiler and the sides of the "saloon." The engine was never built, but the idea was good, though the size of the boiler on a modern express locomotive would not leave room to let the enginemen pass. The designer of the ill-starred *Leader* tried to get over that by setting the boiler over to one side of the frames; but this put the engine so badly out of balance, that the permanent-way department kicked up no end of a shine about it.

A locomotive *could* be designed so that it could be driven from either end, and it would not be difficult to arrange a Garratt-type engine thus; but it has only to be suggested to "the powers that be," and "economics"—how I HATE that word!—come into the picture. The eternal questions: "How much is it going to cost?" and "Is the result worth the expenditure?" will often kill any *worthwhile* innovation; yet huge sums have been spent on useless experimenting. The experiences of motor engine manufacturers with sleeve valves, is a case in point, and lessons might have been learned from it in other quarters. Enginemen are very conservative—I don't mean in a political sense, I hasten to add!—and somehow I fancy they would rather have the Garratt cabs as they are. I know one who would, anyway. He was driving my 2-6-6-4 *Annabel* not so long ago, and said he would like to have one in full size, and show the boys how to take 500 wagons up Sharnbrook bank with her!

"Honourable Mention"

Here are three locomotives, the builders of which are entitled to a spot of friendly congratulation, herewith given. First, the Rev. G. S. Froggatt, of Eastbourne; when he started his locomotive some ten years ago, he was a chaplain in the Forces. The engine is thus the result of ten years' patience and perseverance, and a nice job she is, at that. She incorporates features of several railways; G.W.R. type chimney, Brighton "Atlantic" boiler, L.N.E.R. tender, and Baker valve-gear, and she can do the job in fine style. Our reverend brother says he would like it to be known, that before he started this engine, he knew nothing whatever about building little locomotives, and gained all his knowledge by following these notes, for which kind appre-

(*Continued on next page*)



The three-cylinder 5XP, by Mr. H. Wallis

A Simple Clamping Fixture for Milling

by H. Calvin

I RECENTLY had to form two grooves, $\frac{1}{4}$ in. wide $\times$ $\frac{1}{4}$ in. deep, and exactly parallel, across the face of a block of cast-steel.

Having no vertical slide, I could not end-mill the grooves at one setting, and my smallest machine vice held the job too high to be fly-cut on my $3\frac{1}{2}$-in. lathe.

I solved the problem, allowing me to use a flycutter, as shown in the reproduced exploded drawing.

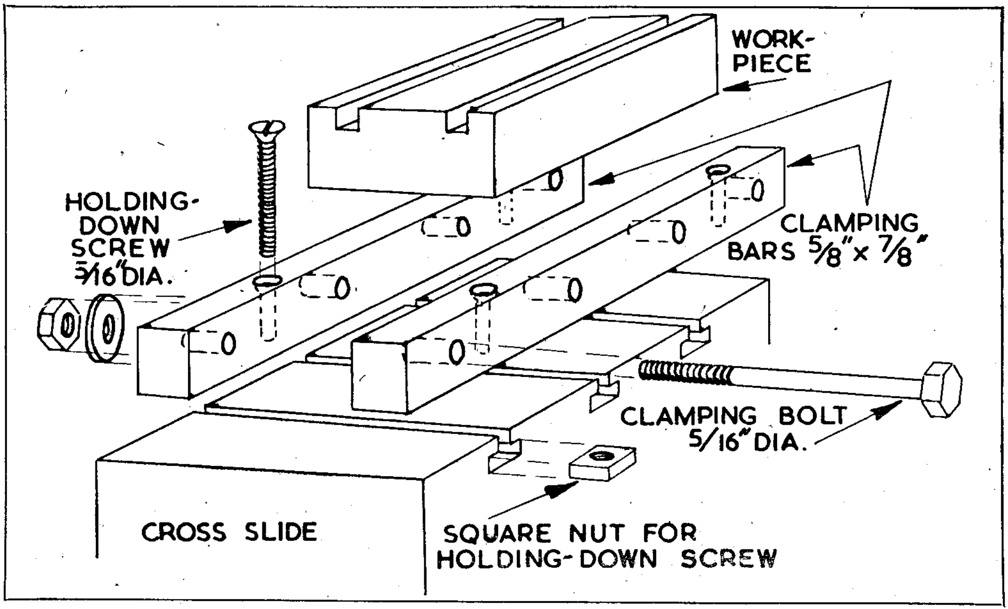
The clamping bars are two pieces of bright-drawn mild-steel, rather longer than the work-piece, and are held down on the lathe cross-slide by four countersunk-head screws in square nuts in the tee-slots.

The work-piece is clamped between the bars by two long bolts passing through holes in the bars above centre height, to apply greatest pressure on the top edges of the bars.

I have not shown all the screws, bolts, etc., on the drawing, for the sake of clarity, and obviously the sizes and hole centres will be governed by the circumstances under which the tool is used and by the machine to which it is attached.

If the bolt and screw holes are drilled clearance sizes, a fair amount of angularity is possible for holding tapered work, and the formation of one or more vee grooves would enable round bars to be held for cutting key-ways, etc.

It may be added that the clamping bars might be found equally useful on the faceplate, vertical slide, drilling and milling machines.



"L.B.S.C." *(Continued from previous page)*

ciation your humble servant bows gratefully.

Secondly, Dr. Garth May, of Brisbane, Queensland, tackled a job that Curly would not now undertake, viz., building a coal-fired live-steamer on "O"-gauge. Well, he did it, and here you see the result. The little engine is a copy of the New South Wales C36 class 4-6-os, and is complete with Walschaerts gear and the usual blobs and gadgets. The worthy doctor has had a bit of trouble in keeping the fire going in such a weeny firebox, but it is only a question of experience. He will get over that in due course. I know more than one fireman who has had trouble in keeping the fire going properly on 4 ft. $8\frac{1}{2}$ in. gauge ! !

Thirdly, a pat on the back for Mr. H. Wallis, of Derby, who tackled a three-cylinder $2\frac{1}{2}$-in. gauge "Olympiade" (L.M.S. 5XP) as a first attempt, and carried the job through to a successful conclusion.

All Tickets, Please !

Several new readers have lately sent me long lists of queries, and have entirely forgotten to enclose a stamped self-addressed envelope for reply. I freely give all the information required when time allows, but I don't reckon to pay carriage on it as well—a nod is as good as a wink to a blind horse ! I had hoped that there would be no necessity to refer to this matter again, but the letters with no return ticket still arrive ; so anybody who wrote and received no reply (personal friends, of course, excepted) will now know why. 'Nuff sed !

A Marking-Out Attachment for the Dividers

by W. M. Halliday

VERY often when marking out hole positions and cavity outlines on a die casting die block, or a plastics mould, the toolmaker will find it necessary and most convenient to be able to strike off the required centres from an existing hole in the component.

The usual toolmaking method adopted in such circumstances, when using the ordinary dividers for the purpose, will be to make a small plug or pin, which is capable of being lightly tapped into the hole. A small centre pip impression will then have to be formed in the end of this plug into which the leg of the dividers may be inserted and located.

If such a pin is of small diameter, and it is not practicable to mount it in the lathe for centring the end in an accurate manner by means of the "Slocombe" type centre drill, errors may easily arise in the positioning of this centre, which would in turn be transferred to the positions marked out on the workpiece.

Very often a pin or plug of the correct diameter may not be readily available, and delays would be occasioned in turning up a suitable plug for the purpose.

The accompanying illustrations depict a most effective and handy attachment for use in conjunction with the ordinary dividers, by means of which all the foregoing drawbacks may be avoided. By using such an attachment the toolmaker will be enabled to strike off centres from any drilled or reamed hole, with close accuracy without having recourse to pins or plug pieces.

The sectioned diagram shown at Fig. 1 illustrates the design and construction of the attachment, and the manner in which it is affixed to the leg of the divider.

Referring to this diagram, *A* is the workpiece to be marked out, and *B* is a drilled hole passing partially through the component from which various centre positions have to be located.

To the pointed end of the divider leg *C* is attached the conical attachment *D*. This member comprises a conical portion formed at 60 degrees included angle and carried to a sharp point as shown. The remaining part of the attachment is turned much smaller in diameter and made parallel to produce the plain cylindrical shank *E*. This portion of the attachment is bored out concentrically for a substantial depth.

Fitted tightly into this blind bored hole is the hard rubber sleeve *F*. This member is provided with a tapered hole passing clean through the part, the smallest diameter being located at the bottom end of the hole as shown.

(*Continued on page* 842)

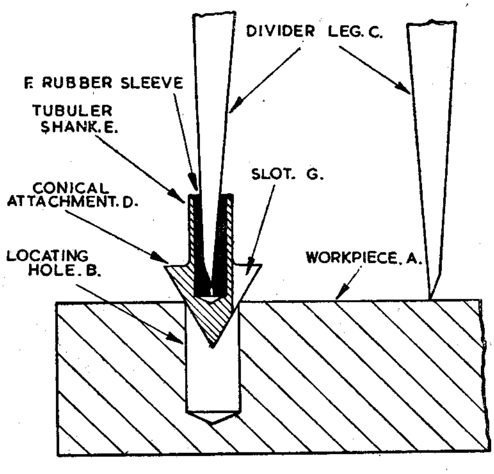


Fig. 1

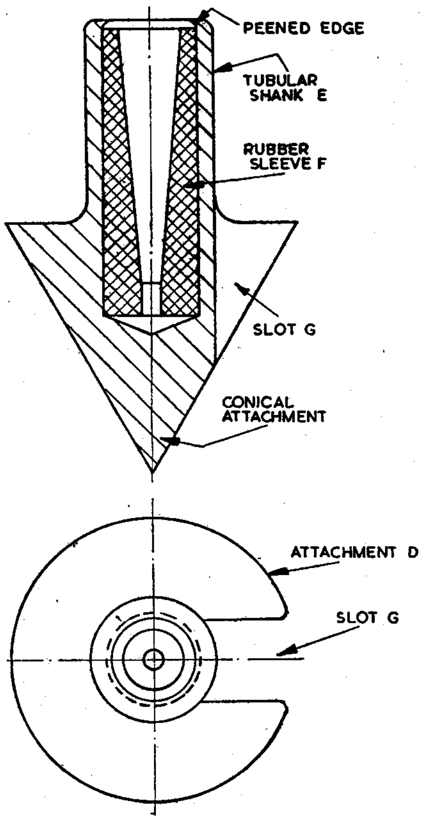


Fig. 2

A Cast Locomotive Frame

by Boynton M. Green (U.S.A.)

SOME time ago I decided to attempt the design and construction of a small steam locomotive and selected an American ten-wheeler, 4-6-0, in gauge "O." Many variations of this type are in use in the United States, and the small gauge was selected because of limitations on space for trackage. No detail drawings being available, it was necessary to work up a free-lance design. When it came to designing the frame, I wished to follow the traditional American bar-type but could not work up much enthusiasm toward sawing and filing the intricate side frames from plate. And, further, it seemed that screwing or riveting the various parts together would not produce a very rigid structure. Well, I finally decided to cast the frame in brass in one piece, and the result, to date, seems to be satisfactory. Certainly it is rigid and accurate, and I think everything will go together properly.

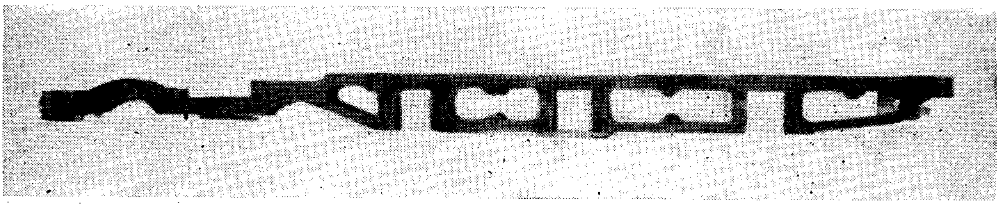


Fig. 1. Side view of the frame

Fig. 1 is a side view of the frame after machining, front end to the left, and Fig. 2 is a tilted view to show the cross members. The front buffer beam is a separate casting, sweated and screwed to the main frame, but otherwise the frame is in one piece. The keeps for the centre axlebox are shown in place. The frame measures $10\frac{5}{8}$ in. long over buffer beams, 1 in. wide outside, $\frac{5}{8}$ in. wide inside, and $\frac{11}{16}$ in. high; the main bars being $\frac{3}{16}$ in. square in section. It is machined on upper and lower straight surfaces and on the outside and inside vertical surfaces across the axlebox openings. All other surfaces are filed sufficiently to clean up. Machining, mostly end-milling, was done on a 9 in. South Bend lathe with a home-made milling attachment. Lengthwise cuts had to be taken in two settings because of insufficient cross-slide travel. Axlebox openings were cut with a circular cutter on an arbor.

When I first considered the pattern work, I visualised a main pattern containing all side openings and a central core, but discussion with an experienced foundryman caused me to change my plans, and form the side openings by small cores pasted to the main core, so the surfaces would not need draft. The main pattern, therefore, is the very simple piece shown in Fig. 3. The pattern is split along the centre vertical plane of the frame and the photograph shows the outside surfaces of both halves of the pattern. The large rectangular block, with one corner cut off, forms the coreprint for the main core. The central rectangular raised portion produces a 1/32 in. machining allowance over the axle portion of the frame. The rectangular blocks at each end form the pouring gates. It was decided to gate at each end because of the very small sections of metal, and a sound casting was produced at the first try. These gates were connected by a runner cut in the parting face of the mould and a single sprue was used.

Fig. 4 shows the main core with the small cores pasted in place ready to go into the mould. The rectangular openings produce the various frame cross members, the large one to the left being that for the cylinder bed. Note that one corner of the core (and the corresponding corner of the pattern, Fig. 3) is cut off to form a register so that the core must be placed in the mould in the proper position. The main and small cores

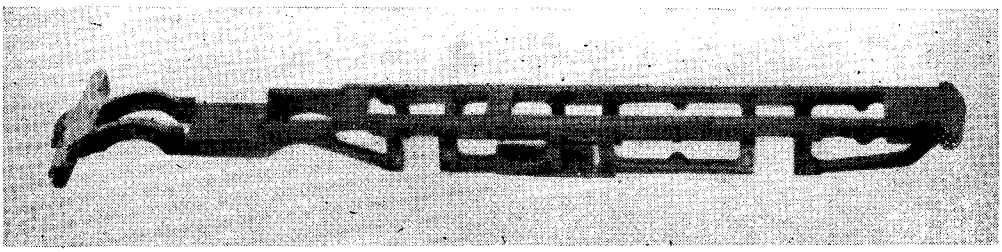


Fig. 2. View of frame, showing the cross members

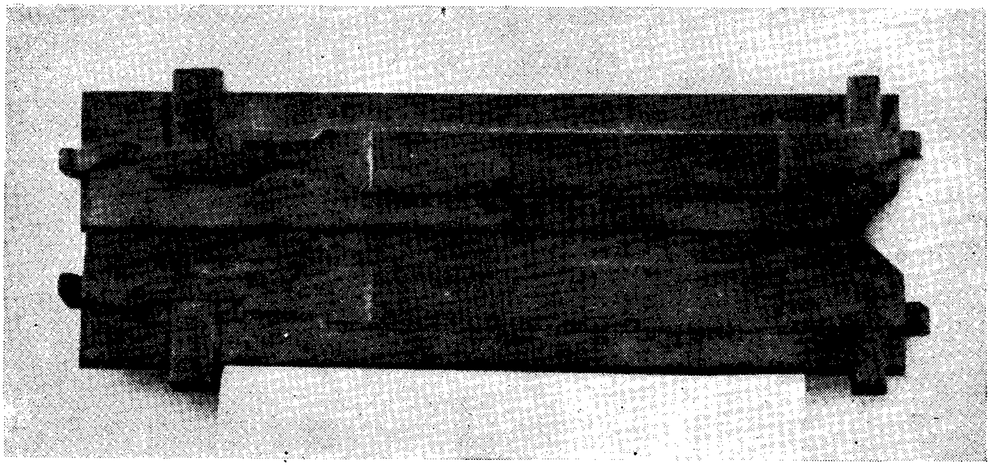


Fig. 3. Main patterns

were in a fine core sand for brass mixed with a synthetic binder and the small cores were attached with a synthetic core cement. The large rectangular depression around the small cores produced a 1/32 in. machining allowance on the inside of the frame.

set on an iron plate which formed the bottom of the box, and loose wooden strips were put through the openings to form openings in the core. Core sand was tamped through the open top and was tucked carefully around the cross strips. Two small iron rods were embedded longitudinally

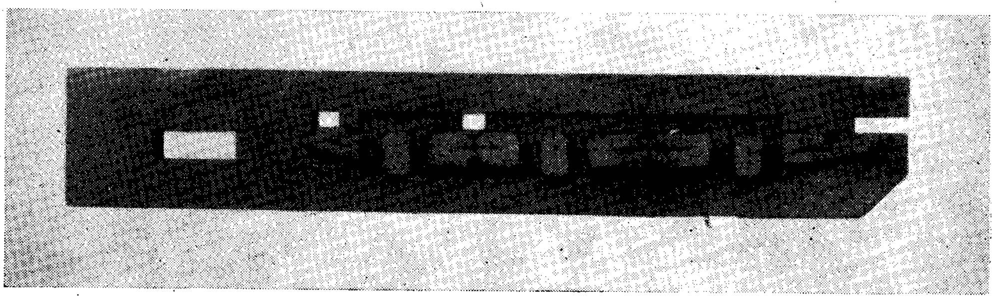


Fig. 4. Main core with small cores attached

The box for the main core is shown in Fig. 5. The small rectangular blocks form depressions 1/32 in. deep for locating the small cores. In use, the two halves of the box were clamped together, being located by the dowels at each end. It was

for added strength. Then the cross strips were pulled out, the box unclamped, and the halves carefully slid sideways away from the core, leaving the block of sand resting on edge on the iron plate ready to be baked.

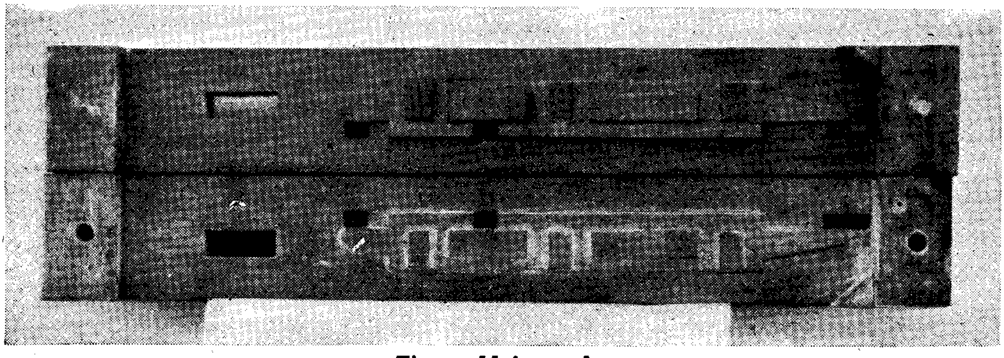


Fig. 5. Main core box

Fig. 6 shows two of the five boxes required to form the various small cores. The box on the left forms the core to produce the frame opening in rear of the trailing axle, and the box on the right produces the core for the axlebox openings. These core boxes are cut from wood a little thicker than the required core thickness. After the small cores were pasted to the main core, all were filed to correct height, by gauge, so that they would just touch the surfaces of the mould when it was closed. These core boxes are so cut that the two halves are self-locating. The box on the right is 1½ in. wide, 3 in. long, and ⅜ in. thick. In use, the box was simply laid on the iron core plate. The two halves were held together with the left hand while the box was filled with core sand and tapped with the right hand. Then the box was tapped gently to free the core and the two halves were carefully slid away.

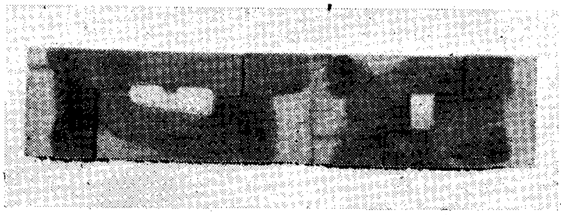


Fig. 6. Boxes for small cores

In closing, one might comment that the procedure described may seem like a lot of work to produce a single frame. The work was undertaken, like much other model work, to try out and gain experience in a very interesting production procedure. Fortunately, I was in a position to carry out all steps myself, from making the patterns to pouring the metal.

A Marking-Out Attachment for the Dividers

(*Continued from page* 839)

The taper hole in this rubber sleeve should be made appreciably smaller than the widest dimension of the divider leg so that this member may be smartly and tightly inserted into the tube.

The lower conical portion of the attachment is provided with a wide slot as at *G*, this extending in depth down to the side of the shank.

When mounting the attachment on the divider leg, the slot should be situated exactly opposite to and in line with the other leg of the tool in the manner depicted.

The purpose of the slot *G* is to allow the legs of the dividers to be brought sufficiently close together for scribing off very short centre distances. Without such a slot this would be difficult to accomplish, owing to the interference of the largest diameter portion of the conical end of the attachment.

The diagrams at Fig. 2, drawn to an enlarged scale, and showing a sectioned front elevation and plan views of the completely assembled attachment, will give a clear indication of the design and construction of the device.

The rubber sleeve *F* should be made slightly shorter than the depth of blind hole machined in the shank *E*, in order that the upper end of the hole may be peened inwards a slight amount in the manner depicted. This is necessary to retain the rubber sleeve in place. The lower plan view also clearly denotes the manner in which the conical portion is slotted at *G* for clearance over the opposite leg of the dividers.

To use this attachment, all that is required is to press the divider leg into the rubber tube, which will then be expanded sufficiently to ensure it being smartly gripped on to the leg of the divider.

Thus mounted, the conical portion of the attachment is simply placed into the hole in the component, as shown in Fig. 1. This action will correctly centralise the divider leg and enable circles of any given radius to be quickly scribed in the usual fashion.

The attachment should be made in tool-steel, and carefully hardened and polished on the conical portion.

This attachment is very simple and inexpensive to construct, and since it is not permanently fastened to the leg of the divider it may be passed on to the tool, or slipped off as convenient.

Because the conical portion is formed with a sharp point, the attachment may be used in very small centre-pipped holes, or impressions. It may be affixed on either leg of the divider as desired.

When making such an attachment care will be required to ensure that the hole in the shank *E* of the device is drilled sufficiently deep to allow the leg of the divider to be inserted therein an ample distance, in order that the point of engagement between the conical part and the hole in the workpiece will be approximately in the same plane as the tip of the other leg of the tool.

IN THE WORKSHOP

by "Duplex"

No. 77.—*The Small Hacksaw Machine as a Lathe Attachment

WHEN designing the power-driven bench hacksaw machine recently described, it was borne in mind that some users, to save the cost of an additional electric motor, would prefer to make use of the existing power drive fitted to the lathe; moreover, the lathe back gear will usually furnish suitable speeds for driving the machine direct, thus obviating the need of a special reduction gear. The cost of making the machine is therefore greatly reduced as the driving mechanism to provide the necessary speed reduction is dispensed with and, instead, the drive is taken directly from the lathe mandrel. Again, should it be decided later to convert the lathe-driven model to the bench type machine, this can easily be done by building the self-contained drive on the existing bedplate, for, apart from the clamping mechanism, use can be made of all but two of the parts already made, that is to say the short driving shaft and the shortened bracket that carries the beam pivot arm. The disadvantages of using the machine on the lathe are common to most additional lathe fixtures, namely: that time is occupied both in fitting and removing the attachment and, while it is in place, the lathe is not immediately usable for other operations. As to the time taken to fit the hacksaw, this can be done in a few seconds and much more quickly than, say, removing the top-slide and fixing the vertical milling slide in place on the cross-slide of the lathe; all that is necessary is to run back the lathe saddle, put the clamp-bolt in position, place the machine on the bed and slide it to the left so that the crankshaft enters the chuck jaws, then tighten the chuck and the clamp-nut. The crankshaft, shown in the photographs, forms part of the machine and always remains attached to it. The guide bar, which makes contact with the back of the lathe bed, ensures that the machine is correctly aligned, and the clamp-nut, when tightened, draws the clamp plate against the underside of both bed shears.

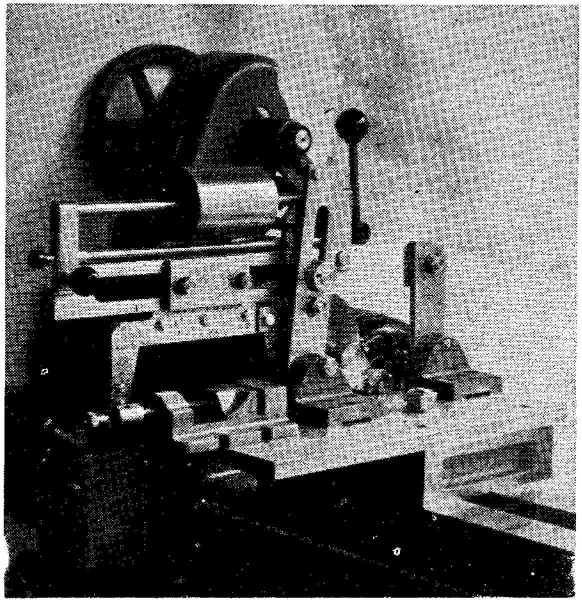


Fig. 62. The machine mounted on the lathe

The mounting illustrated has been designed for a lathe of 3½-in. centre height, and the clamping mechanism is suitable for the Myford "ML7" lathe; nevertheless, adjustment for height can be made by varying the thickness of the raising blocks attached to the underside of the baseplate, and the method of clamping the machine to the lathe bed can readily be altered to suit lathes of other types. As a guide to the most suitable clamping arrangement, the method by which the fixed steady or the tailstock is secured to the bed may be followed, but with the Drummond-Myford form of bed, for example, the position of the clamping-bolt may also have to be altered.

Construction of the Machine

The dimensions of the bedplate are similar to those specified for the bench model, but the driving mechanism consisting of a countershaft and crankshaft carried in bearing brackets is no longer required; instead, a shortened bracket is used solely for mounting the beam pivot arm, and the modified crankshaft is gripped in the lathe chuck.

The connecting-rod and all the parts which follow it, constituting the sawing mechanism, are in every way similar to those already des-

**Continued from page 753, "M.E.," November 16, 1950.*

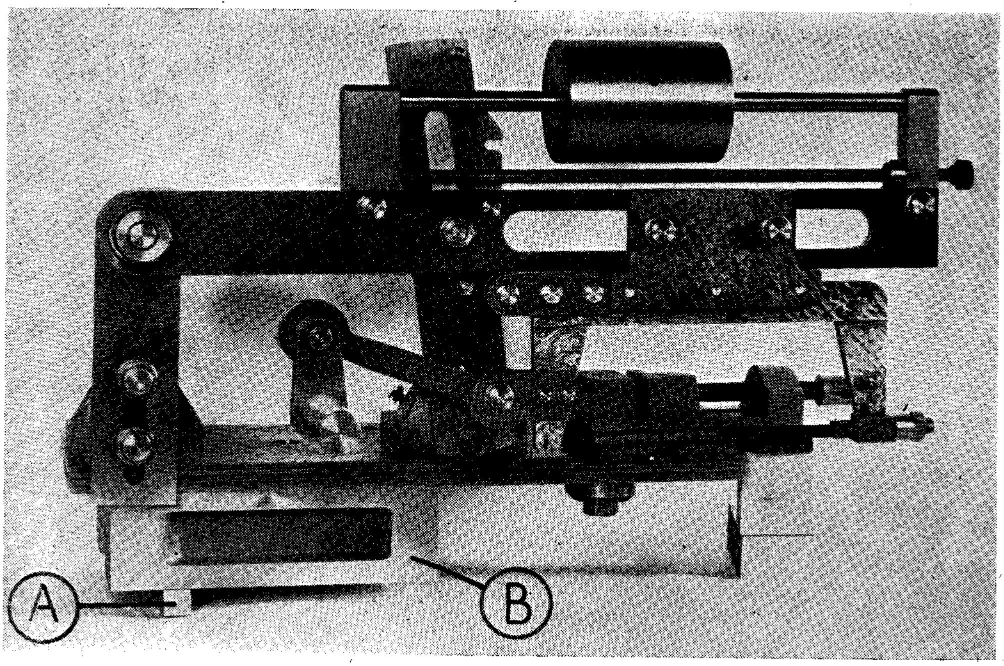


Fig. 63. *Front view of the machine : " A " is the guide strip and " B " one of the two raising blocks*

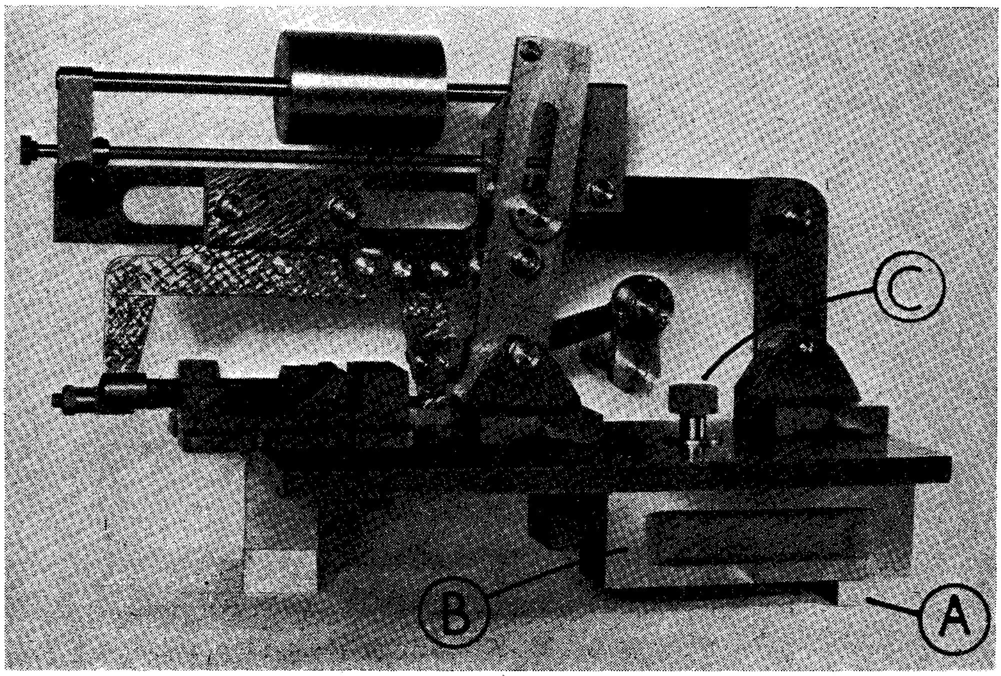


Fig. 64. *The machine seen from the back : " A "—the guide strip ; " B "—a raising block " C "—the clamping-nut*

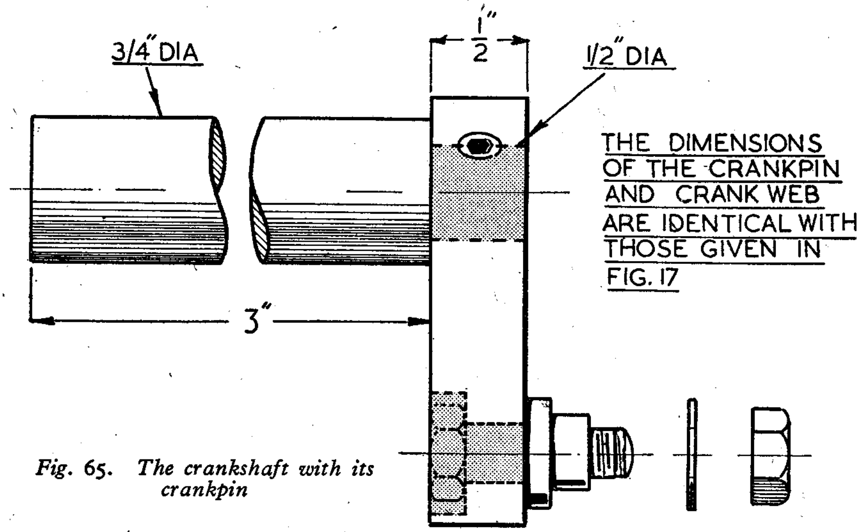


Fig. 65. The crankshaft with its crankpin

cribed for the bench machine. There is, however, no need for any electrical switchgear or wiring, as this all forms part of the lathe motor equipment. Nevertheless, if the need arises, a Burgess switch can be fitted as in the bench model to switch off the motor, at the end of the saw's travel; but, if this addition is made, care must be taken to ensure that there is no unprotected live wiring. In view, therefore, of the account already given of the bench machine, the present description is limited to giving details of the modified crankshaft and the construction of the parts employed to secure the baseplate to the lathe bed. In addition, it should be noted that the bracket for mounting the beam pivot arm need be only half the former length, as it no longer carries a countershaft for the drive mechanism; as will be seen in the illustrations, this bracket is attached to the baseplate with three Allen screws in the same was as the guide arm bracket.

The Crankshaft

The form of the modified crankshaft is illustrated in Fig. 65, and for the constructional details of the crankweb and the crankpin, reference should be made to Fig. 17 in a previous article of this series. As the connecting-rod is similar to that already described, there is no need to do more than recall that the big-end is fitted with a ball-bearing having a bore of $\frac{3}{8}$ in. In addition, for the sake of uniformity, the crank itself and its crankpin are also counterparts of those previously used. The exact diameter of the crankshaft is not of importance, but it should be made sufficiently large to mount the crank securely and at the same time to afford a good gripping surface for the chuck jaws; moreover, the shaft should be long enough to make contact with the full length of the chuck jaws, but should overhang no farther than is necessary to clear the gap in the bed and drive the machine.

The crankshaft illustrated is made $\frac{3}{4}$ in. in diameter in order to provide an adequate abutment shoulder for

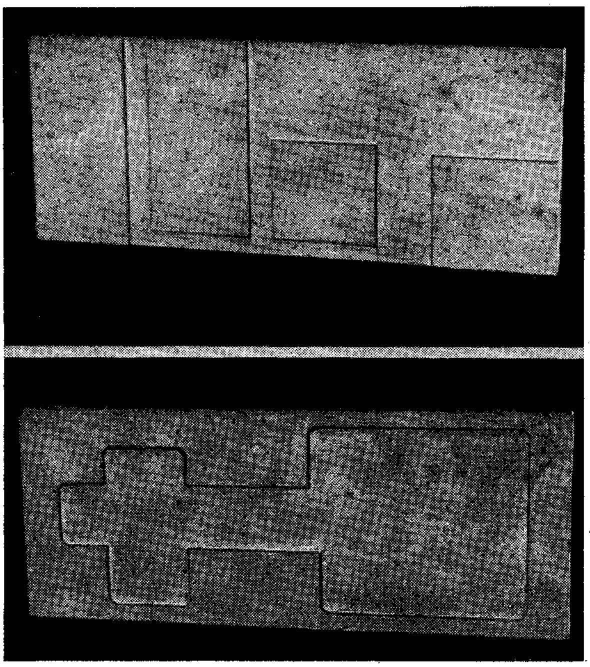


Fig. 66. The cast aluminium bedplate: Above—the upper surface; Below—the under side of the casting

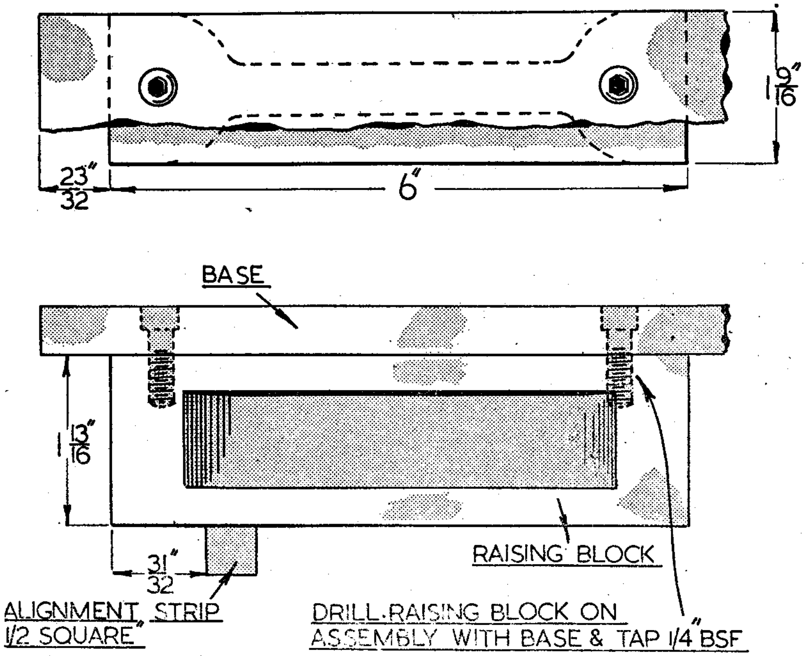


Fig. 67. The raising blocks and guide strip

The length of the seating for the big-end ball-bearing must be made a few thousandths of an inch less than the width of the bearing so that, when the retaining nut is tightened, the inner race is securely gripped and kept from turning. The power required to drive the saw is so small that there should be no need to fit a driving peg to the crankshaft to bear on one of the chuck jaws, but, if the chuck jaws are worn and do not close evenly, this fitting may be found necessary and will save further straining of the chuck due to having to over-tighten the jaws the crank. This shaft should be turned between centres to ensure that the crankweb, carrying the crankpin, lies at right-angles to the axis of the shaft and so that the crankpin itself is parallel with this axis. The crankweb is secured to the faceplate for boring the seatings for both the crankshaft and the crankpin to afford light press fits. Although a single Allen screw will probably serve to fix the crankweb in place, two screws are fitted here to afford greater security. The crankpin can be turned to size when mounted in the self-centring chuck and then reversed for turning the other end, for, although it is essential that the two register portions should be formed truly parallel with each other, an eccentricity of a few thousandths of an inch is, here, immaterial, as this will at most alter the length of the stroke by a like amount.

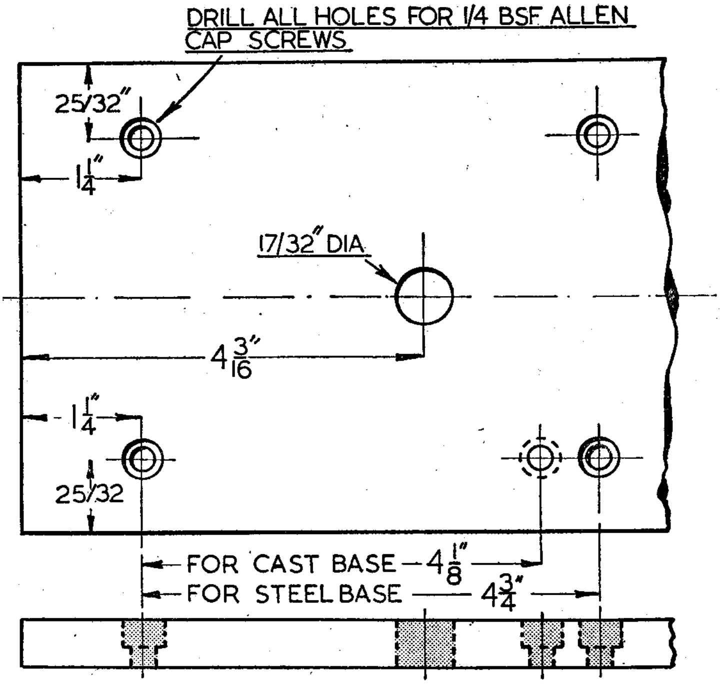


Fig. 68. Drilling centres on the baseplate for the raising blocks and clamp bolt

The Bedplate

As in the previous model, a steel bedplate is used; however, owing, perhaps, to the uncertainty of supplies of steel, Mr. H. Haselgrove has kindly undertaken to supply bedplates, cast in aluminium alloy, of a pattern that will serve for either the bench or the lathe machine. As illustrated in Fig. 66, these castings are

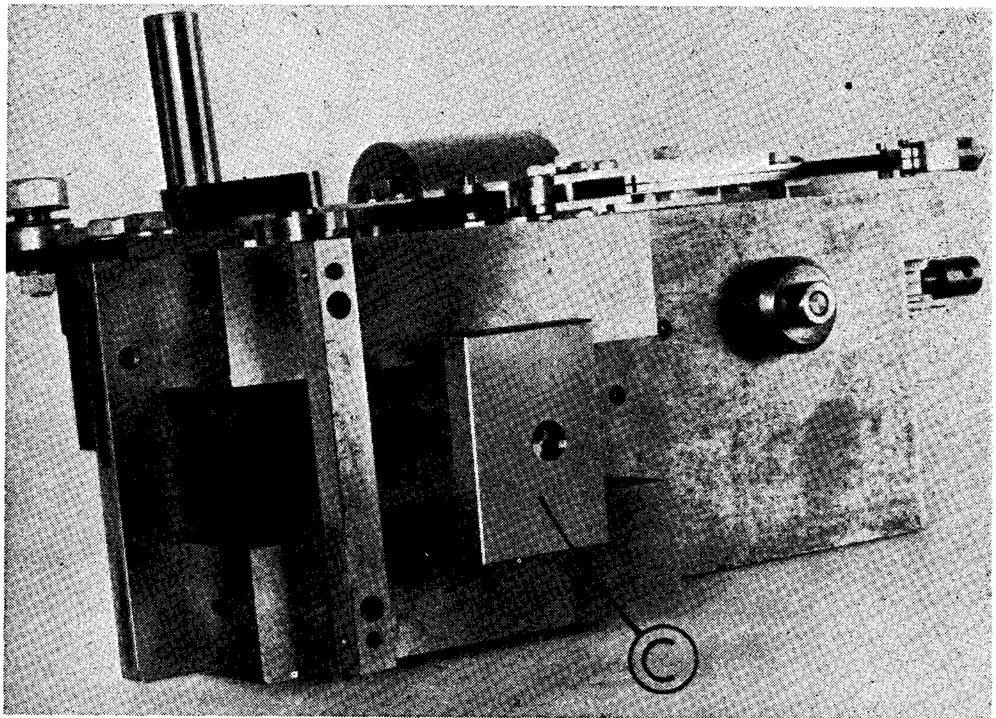


Fig. 69. Underside of the base, showing the raising blocks, the guide strip and the clamp bolt with its clamp plate, " C "

urnished with filing strips for mounting the various components in place. These filing strips greatly reduce the work of finishing the casting, for the strips alone have to be filed flat and not the whole surface of the plate; this operation is best carried out by using a large file and plying it in the direction of the long axis of the casting. Aluminium filings are, of course, apt to form pins in the file teeth and cause scoring of the work surface, but this trouble can, in part, be overcome by exerting only light pressure on the file and applying oil or paraffin to the work. If a so-called milling file, having deep grooves between the teeth, is available, the work will be made easier and there will be no trouble from pinning. The flatness of the work surface should be tested from time to time on a surface plate, or on a sheet of plate-glass, lightly smeared with marking compound, and those who wish can finish the truing operation by using a hand scraper.

The Raising Blocks

These blocks are iron castings and are attached to the underside of the baseplate by means of Allen screws inserted from above. The castings are machined in the lathe by gripping them in the four-jaw chuck, or the work can be done equally well in the shaping machine. The dimensions of these fittings are given in Fig. 67, and their position on the baseplate is indicated in Fig. 68, as well as in the photographs.

For lathes other than those of $3\frac{1}{2}$-in. centre height, the height of the raising blocks can either be reduced, or additional packing strips can be fitted to the casting when the overall height has to be increased.

The Alignment Strip

As shown in Fig. 70, this guide bar consists of a length of $\frac{1}{2}$-in. square mild-steel, attached to the under surface of the two raising blocks in the way illustrated in Fig. 67, and also in the photographs. The purpose of this strip is to align the bedplate squarely across the lathe bed, but, to allow any necessary adjustment to be made, the strip itself is furnished with setting-screws which can be locked by grub-screws.

When the machine is being clamped to the lathe bed, the bedplate is pulled towards the

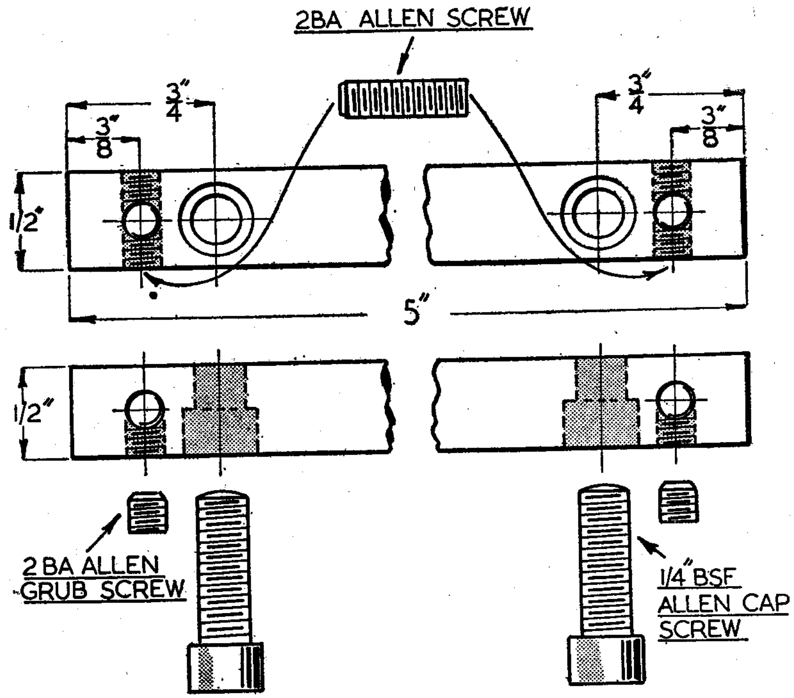


Fig. 70. The guide strip with its fixing and adjustment screws

operator and the clamping-nut is tightened while the guide strip is kept in contact with the back shear of the lathe bed.

The Baseplate Clamp

The baseplate is clamped to the lathe bed by means of a clamp-bolt consisting of a clamp plate, a long stud, and a clamp-nut and washer at the upper end. It will be noticed in Fig. 71 that the clamp plate is shown bevelled at its forward end; this allows the plate, when placed in the bed gap, to slide into position between the bed shears even when a chuck or other fitting is mounted on the mandrel. When in this position, the clamp plate will fall for only a short distance, and there will be no difficulty in dropping the bedplate over the upstanding end of the clamp stud; this manoeuvre is faciliatated by making the hole in the bedplate 17/32 in. in diameter or even larger.

On tightening the clamp-nut, the two pressure surfaces formed on the clamp plate bear against the underside of the bed shears; as this pressure is transmitted directly to the raising blocks, there is no tendency to distort the lathe bed. However, if the machine is built up on the cast aluminium bedplate, it is advisable to fit a substantial plate, instead of an ordinary washer, beneath the clamp-nut; there will then be no danger of distorting the casting when the nut is firmly tightened. This saddle plate should be of the same form as the lower clamp plate, that is to say it is relieved in the centre so that two pressure pads are formed to bear directly over the raising blocks.

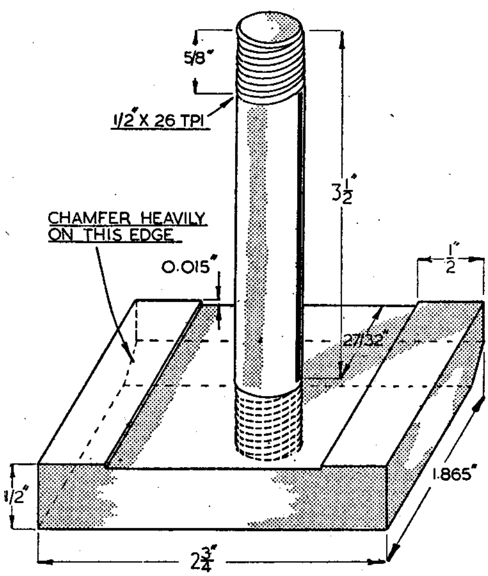
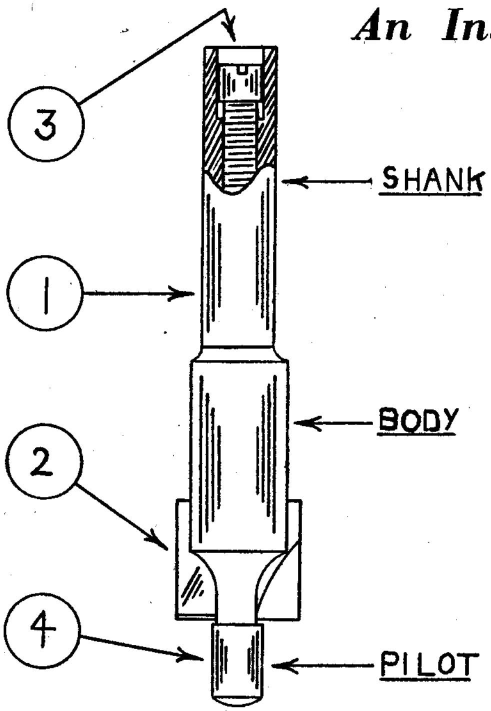


Fig. 71. The clamp bolt

In response to numerous enquiries, and to save readers unnecessary correspondence, we are able to state that Mr. H. Haselgrove has arranged to supply full sets of castings and materials for building either the bench hacksawing machine or the lathe attachment.

An Inserted-Blade Pin-Cutter



by F. W. Rason

CERTAIN operations necessitate the use of a counterbore or pin cutter, and for frequent use and long runs, especially where ferrous metals are involved, one cannot do better than to employ a good commercial "high speed" steel counterbore. These are obtainable either as single solid cutters or in sets comprising interchangeable cutter heads and pilots; however, for the model workshop, the amount of work involved in such operations does not usually justify the costly purchase of such, and it is therefore common practice to make one's own, in which case the hardening facilities available usually limit the tool material to "plain" carbon steels.

Apart from their specialised uses for such operations as recessing and spot facing, the pin cutter has other advantages which make its use preferable in many instances to a conventional drill; especially is this so when boring holes from say $\frac{5}{16}$ in. upwards in small gauge materials. For such operations the pin cutter can be relied on to cut the size expected of it; the hole will be round and clean, and "catching up" is almost non-existent, which in general instils a greater measure of confidence in the user.

The suitability of a cutter for spot facing and recessing may be largely dependent on the permissible size of the pilot hole, but for the singular purpose of cutting holes the pilot size is influenced only by the considerations of reasonable cutting conditions. It was for this latter application that the writer was most interested, and in seeking a partial solution to the problematic inconvenience of making innumerable cutters that the design herewith described and referred to as a pin cutter, was evolved. Whilst it is not intended to compete (as regards heavy duty work) with solid and more technically correct designs, it is thought that the simplicity of making the interchangeable blades may prove rather attractive. Under general working conditions they have given every satisfaction.

Basically, it is a development of a method common to bar-and-cutter boring tools, the main considerations being as follows:

1. Self centring of cutter blades.
2. General rigidity.
3. Simplicity of blade design.
4. Size of pilot.

The requirements of self-centring are met by slotting the cutter blade and machining two keyways through the pilot and well up into the body; these keyways are cut to a depth calculated to give a fair amount of support to the blade, and providing the fitting is kept within close limits a sound interlock is created, being finally clamped by means of a locking screw passing down the shank.

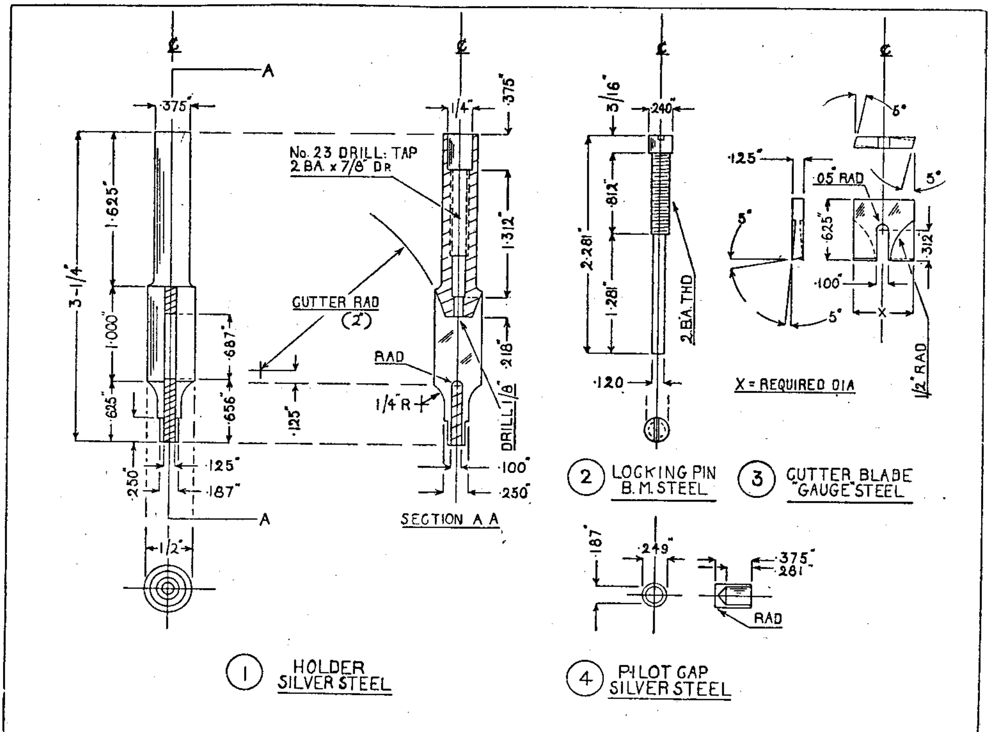
The blades are made from ground flat stock (high carbon steel) often referred to as "gauge plate," and are heat treated as per normal practice; a satisfying feature of the design being the ease of stoning or re-grinding the cutter edges.

To effect a keyway of suitable proportions, and at the same time preserving a reasonable margin of strength, naturally imposes a limitation on the minimum diameter permissible for the pilot. The size resulting from these considerations and chosen as being most suitable for the range of cutters involved (say $\frac{3}{8}$ in. to $\frac{3}{4}$ in) is 0.250 in. diameter; strictly speaking, however, the actual size can be no more than a compromise where a large range of cutters is used with a common pilot, because within certain limits the pilot should increase relative to the cutter size. Such a condition reduces the amount of material removed by the cutter and so relieves the loading on the tool. This relation between cutter and pilot begins to assert itself if diameters larger than $\frac{3}{4}$ in. are attempted. (This latter statement is based on cutting mild-steel and may be exceeded where softer materials are concerned.) Such a relation may be complied with for larger sizes if a sleeve is fitted to the existing pilot, but caution must limit this practice to within the reasonable possibilities of the tool as a whole. If larger sized holes are the rule rather than the exception, then a

holder of more ample proportions should be considered.

The Holder

Detail 1. The holder is a single turned piece and comprises the shank, body and pilot; a detailed sequence of machining operations will not be given as these will depend largely on available facilities; the important point to bear



in mind is the relative concentricity of shank and pilot.

A few notes on the blade interlocking section may prove an advantage, because that which may appear somewhat complicated from the drawings actually resolves itself into a few simple operations. A study of the photograph will show an incompleted version of this section, which with the aid of the following notes will make the procedure quite clear.

At a suitable stage when the pilot at least has been turned to size, mark out slot and keyway, then drill a series of holes to suit; these should be preferably of a diameter less than the finished slot size (a No. 32 drill is suitable and this will allow for correction of any drilling errors when cleaning out the webs), after which set up carefully and proceed to mill keyways.

Although the original was machined with a 4 in. cutter as per drawing, it will be apparent that the required results may be effected by quite a small cutter set up in the lathe. When this has been accomplished, the amount of drill web left to be filed out is quite small; this, however, must be done with care and patience to preserve the accuracy of the slot, and is best carried out using a sample cutter blade as a fitting standard.

Cutter Blades

To produce a blade, cut a piece of material of suitable size and square up two edges to $\frac{5}{8}$ in. as per drawings (this will be standard for all blades). The dimension X may be of rough finish, but in excess of final requirements. Machine or file slot to size and then locate securely in the holder (Detail 1) clamping by means of the locking pin (Detail 2), the shank of Detail 1 is then mounted in a lathe and used as a spigot for turning dimension X of the blade to finished requirements.

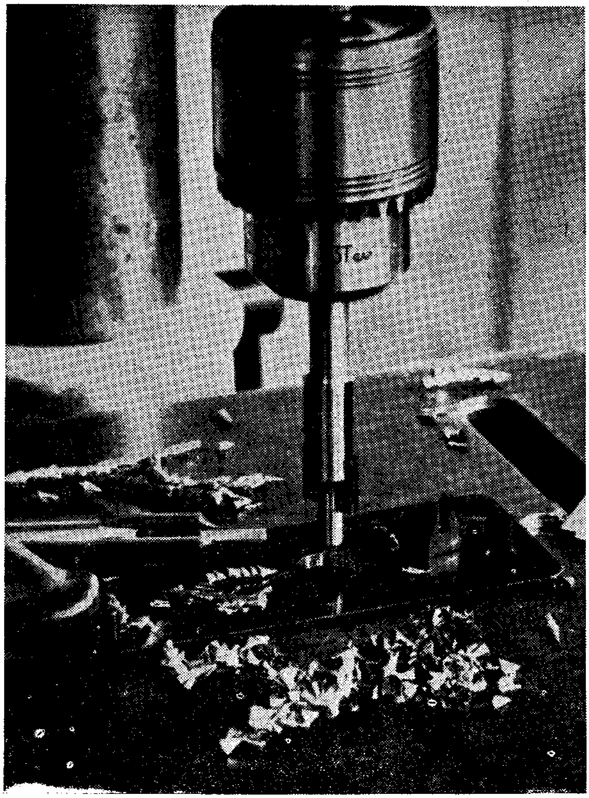
Before removing blade for the next operation, make a reference mark on the blade to coincide with a similar mark on the holder; this will ensure that the blade is subsequently returned to its original position of mounting as per the turning operation.

Form the cutting angles as drawing (Detail 3); the "backing off" angle is shown to be radiused on the face, resulting, of course, from the method used, i.e. milling. This was found to be most convenient, although it may be filed, but whichever method is used, it is most important to avoid interference with that portion of the blade face which constitutes a locating surface with

the body and pilot (see assembly drawing).

The slot radii shown in drawing should have been adhered to, as sharp corners are often the cause of fracture during the hardening process ; in any case such corners are invariably a source of weakness and should be avoided where possible throughout.

Prepare now for hardening by securing the blade with a piece of iron wire and bring to red heat (800 deg. C. approx.). Quench in water which has been topped with oil and agitate freely until cool ; clean the surfaces and make ready for tempering, which must be carried out carefully, as much may depend upon this operation.



The finished tool in operation, together with incomplete version, showing method of forming blade interlock

The cutting end of the blade alone needs this high quality of hardness (yellow), while the base end, extending at least to the slot radius, needs toughness (blue). On this reasoning, then, it is not good enough to temper the blade to a common hardness. It is, of course, well known that such a condition is produced automatically if the complete colour range of tempering is incorporated in a hardened workpiece, and such must be the objective ; special mention of it is made, however, because it becomes increasingly difficult to incorporate such selectivity in small articles, and one may be tempted to produce a common temper which in this particular case is most undesirable. Fortunately, the length of blade is such that with reasonable care the range of blue to yellow is just accommodated. The method used was quite simple and entails holding the base end of the blade in an old toolmaker's clamp and by playing the flame on the limbs rather than on the blade itself a good measure of control is gained ; observe the colours run up and quench in water when a medium yellow approaches the cutting edge. This should just coincide with a changing blue at the base.

It will be appreciated that blades less than the body diameter, e.g. $\frac{1}{2}$ in., will have a limit to their depth of penetration. For the smallest practical size, which is in the region of $\frac{5}{16}$ diameter, this amounts to $\frac{1}{4}$ in. It is recommended that blanks not less than $\frac{1}{2}$ in. wide be used for the smaller sizes, the required diameter being stepped down accordingly ; reference to the photograph will show two samples made thus, the object of which is to preserve a good bearing area at the base of the blade.

Pilot Cap

The keyways extending to the working end of the pilot are only a matter of convenience appertaining to the ease of the machining operation involved, but as they present certain objections to smooth running, it is necessary to eliminate their influence. This is accomplished by turning the pilot end down and fitting the cap (Detail 4). A good push fit should be aimed at, and finally secured by either pinning or soft solder ; the latter has been used with satisfaction and may be preferable for possible interchange of pilot sizes. If the cap is left oversize when fitted, it may be turned to size *in situ* thus ensuring concentricity. (Note the dimensions are such that the edge of cutter blade does not bottom on the pilot cap. This is important.)

To sum up, the tool may be used for most of the everyday materials, being particularly suited to brasses ; mild-steel too may be cut, provided the speeds are reasonably slow and a copious supply of cutting oil or compound is used.

Bearings & Associated Industries Ltd.

We have been advised that, by mutual agreement, the selling arrangement by which Bearings and Associated Industries Ltd. were the sole representatives for British Manufactured Bearings Co. Ltd., of Crawley, has been discontinued. A new company B.M.B. (Sales) Ltd. has been formed for the purpose of providing sole sales representation for British Manufactured Bearings Co. Ltd.

In future, therefore, all sales enquiries and orders for B.M.B. miniature steel balls and bearings should be addressed to B.M.B. (Sales) Ltd., 2, Balfour Place, Mount Street, London, W.1. Telephone No. Grosvenor 3155.

PRACTICAL LETTERS

Barronia Metal

DEAR SIR,—In reply to your note on the foot of page 580 of THE MODEL ENGINEER for October 12th regarding the present address of the manufacturers of Barronia Metal, we would like to inform you that we have recently been in correspondence with them and the address is: Barronia Metals (Great Britain) Ltd., Metal Founders, Precision & Research Engineers, Hereford, England.

We trust that this will be useful to you and we might add that they publish a very interesting book entitled *Copper Alloys for the Engineering Industries*, describing the various metals they manufacture and their uses.

Yours faithfully,
Portslade. J. F. RAMUS.

Cornish Pumping Engines

DEAR SIR,—I am extremely interested to note that my memo which appeared in "Smoke Rings" of July 13th issue, has created so much enthusiasm regarding the old-time Cornish pumping engines. There are now only three working in Scotland, and I have no doubt that if a set of drawings were produced, a further field would be opened, as I have had numerous letters requesting further details of the one at Prestongrange Colliery, Musselburgh.

Messrs. Shell-Mex have produced a very good film on this subject; we showed it in our club last year, and it proved to be so popular that I have been asked to arrange a repeat performance.

I find that there are a large number of model engineers who desire something different, and this engine should meet their requirements.

Yours faithfully,
Edinburgh. JAMES H. FARR.
Hon. Secretary,
Edinburgh S.M.E.

Refrigerants

DEAR SIR,—With reference to the letter by Mr. D. Brother in your issue of September 21st, he is correct in stating that Freon 12 and Arcton 6 are the best for use in domestic refrigerators, but there are problems in its use quite apart from the difficulty of obtaining supplies. It is odourless and slight leaks can only be detected by means of the special Halide torch as used by Servicemen. Methyl chloride is similar in smell to chloroform, but it requires to be present in a volume 10 per cent. of the total air before it acts as an anaesthetic. However, it can cause drowsiness which lulls the senses before unconsciousness overtakes the victim.

Sulphur dioxide combines readily with water, but in any case the system should have been carefully dehydrated before charging. Its pungent odour gives warning of the slightest leak, but a piece of cotton wool soaked in household ammonia will soon reveal the point of leakage by the formation of white smoke. Its main advantage is in the fact that it can be obtained in 3 lb. syphons at 6s. 8d. per lb., plus 20s. on the syphon, of which 17s. is credited on return. These are supplied by A. Boake Roberts & Co. Ltd., Stratford, London, E.15, and when ordering, allowance should be made for carriage and 10s. or so for a returnable packing case. These people are most helpful and the usual disclaimer is added.

Yours faithfully,
Merton Park. "FACITUR."

Model Traction Engine

DEAR SIR,—May I say how absolutely first class the showman's road locomotive looked, built by Mr. Richardson. But I don't know why it should be called a "Fowler" class of engine. It is most decidedly a Foster style, the peculiar chimney rim they fitted to cover the hole in the cab was a salient feature to start with. Also, the steering wheel on the near side puts the Fowler question out again (they *did* have one or two smaller engines with this side) as Fowlers were fond of offside as a general practice.

The Foster had a neat bunker, whereas the Fowler looked always long and low. Fowler engines were everything desired, as regards workmanship, but not too good to look at.

The boiler was very small in proportion to what were very fine massive cylinders and gear. No, the Foster and Burrell were miles ahead for symmetry and graceful outlines, as compared with the "Johnny F." engines.

I daresay Phillip Bradley and others will not fail to notice the engine as a Foster first and last. That dynamo, built up bracket is another feature to make one "foster" the Foster idea.

Yours faithfully,
Erith ALAN BLOW.

Electrified Fences

DEAR SIR,—*Re* your reply to Query No. 9863, I remember seeing, in America, a home-made electrified fence, which might be of interest to C.E.R. (Carlisle).

Although I am unable to give a full description of the apparatus, I do remember the source of power was a 6-V car battery, which was connected to an old pattern Ford ignition coil. Fixed to the top of the coil was a length of glass tube large enough to take an ordinary marble. The coil and tube were mounted on a table so that they lay at an angle of approximately 15 degrees to the horizontal. When the marble was placed in the tube it rolled down and operated a make-and-break. Somehow, I don't know how, it got flicked up the tube only to roll back down again and maintained a constant make-and-break action.

Yours faithfully,
Dumfries. W. SUTHERLAND